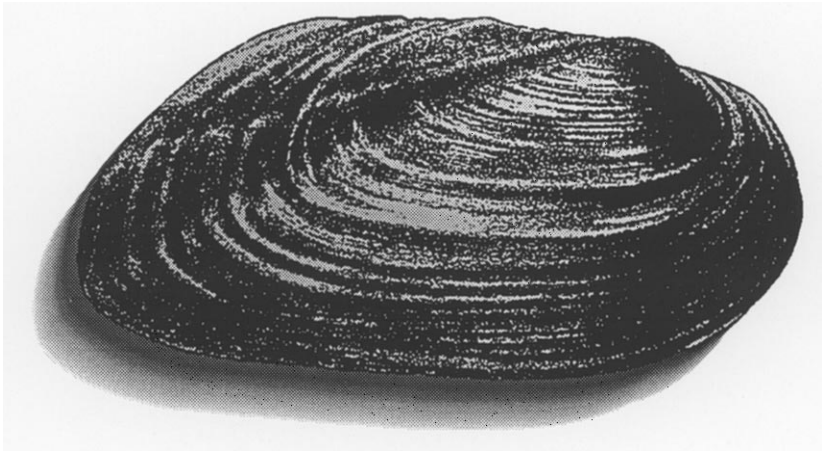
MANUAL OF THE FRESHWATER BIVALVES OF MARYLAND



CHESAPEAKE BAY AND
WATERSHED PROGRAMS
MONITORING AND
NON-TIDAL ASSESSMENT
CBWP-MANTA- EA-96-03

MANUAL OF THE FRESHWATER BIVALVES OF MARYLAND

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INTRODUCTION

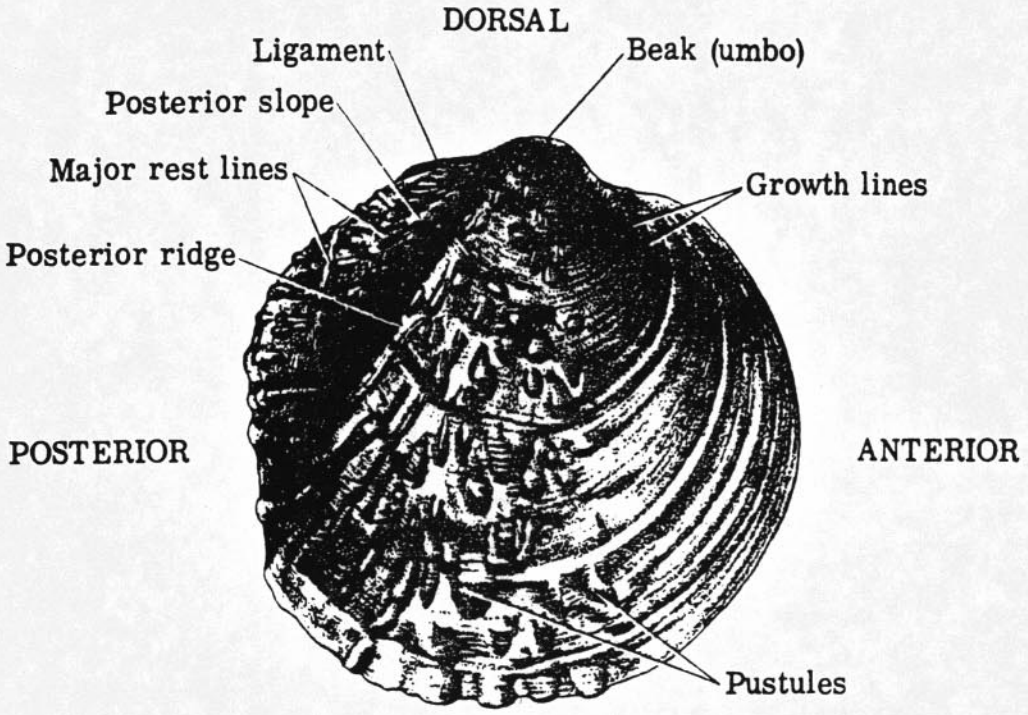
The freshwater bivalves of the state of Maryland are represented by 1 introduced species and historically by 17 native unionid species in the Chesapeake Bay Basin and by 22 species prehistorically in the Monongahela River Basin. The only comprehensive monograph of the freshwater bivalves of the region of including Maryland and Pennsylvania was prepared by Arnold E. Ortmann (1913, 1919), while working at The Carnegie Museum of Natural History, Pittsburgh. This workbook is designed to provide an introduction to the freshwater bivalves of Maryland. This is accomplished by providing a list of all of the freshwater bivalves, excluding Sphaeriidae, their common names and distribution by river basin. A key based on shell characters for all of the species, except Sphaeriidae, is provided. Each unionid species has a detailed shell description and is supplemented by a color figure of a representative specimen of the species. A glossary is included to obviate any obscure descriptive terms used in the notebook. An introductory bibliography is included to facilitate entry into the literature on all three families of freshwater bivalves occurring in the state. The bibliography is broken down by family and is subdivided by major topic under Unionoidea.

The purpose of the workshop is to train regulatory agency personnel and other interested parties in recognition and identification of freshwater bivalves that either are known or suspected to occur in Maryland. It is hoped that such training will lead to increased knowledge of species distribution in the state. During the workshop participants will be exposed to the diversity of North American freshwater bivalves and the importance of these animals in aquatic ecology. There will be sufficient material of each species to examine so that participants will have an opportunity to begin to develop an idea of the range of variation within species reported from the state. The combined use of the key, figures and descriptions of the species should help the participants to learn which characters are important in the identification of shells of these species.

The format for each of the species accounts includes: a map of the historic distribution of the speices but does not include the most recent survey data (eg. Bartgis and MacIvor, 1993), the basic map was modifided from Gerberich (1984); common names follow Turgeon et al. (1988); synonymy includes junior synonyms and previous generic combinations; shell description is a detailed list of the characteristics of the shell of the species described; distribution is the list of states in which the species occurred historically based on Williams et al. (1993); ecology is the published notes on the ecology of the species; breeding season is that period of the year when female specimens have been observed with glochidia in the marsupium; fish hosts are noted where known as compiled from the literature by Watters (1994); status is the perceived status of the species throughout it range as presented by Williams et al. (1993).

ACKNOWLEDGMENTS

The bibliographic citations used in this volume were taken from the author's work in progress on the bibliography of unionids of North America with Kevin Cummings and Clement L. Counts, III. The use of this bibliography greatly facilitated the development of the literature section. John Christmas was instrumental in developing the workshop and revising the key to the freshwater bivalves of Maryland. Dr. John Rawlins, Curator of Invertebrates, Carnegie Museum of Natural History, Pittsburgh provided access to the collection for the photography of several species of unionids and provided specimens for the workshop. The Delaware Museum of Natural History and Dr. Paula M. Mikkelson, Curator of Malacology graciously provided study specimens used during the workshop.



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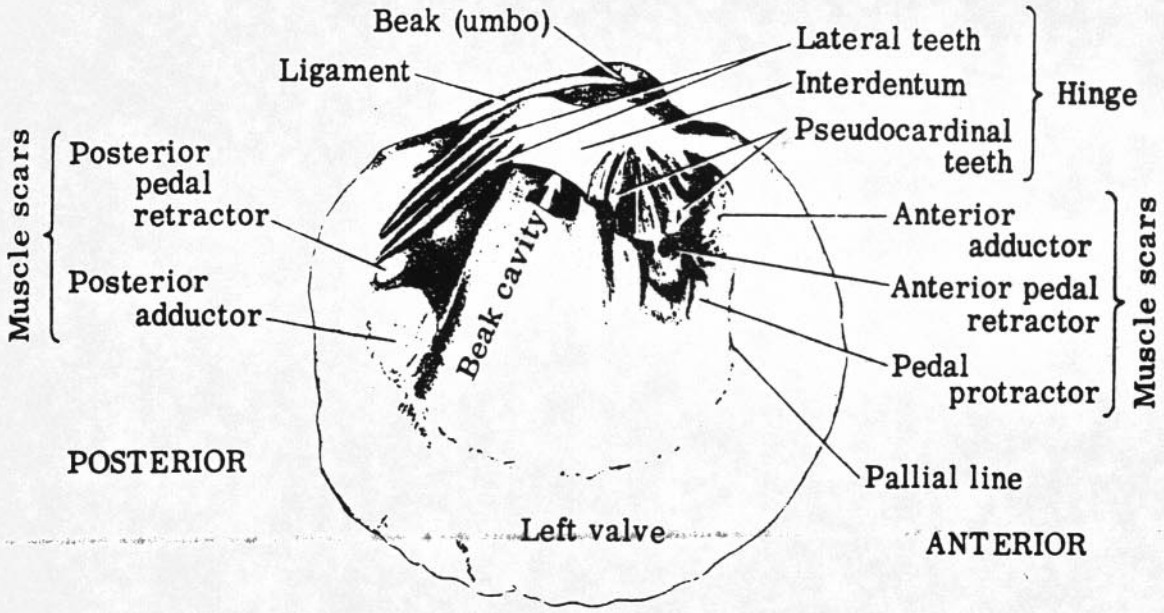

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Figure 1. Morphology of a freshwater mussels shell illustrating structures and terminology. a. exterior of right valve, b. interior of left valve. (from Burch 1975:5, fig.2; Bogan and Parmalee 1983:9).

GLOSSARY OF BIVALVE TERMS

Alate - with an extension or wing on the dorsal edge of the shell.
Angular (subangulate) - having either the anterior or posterior margins forming a relatively acute (sharp) angle.
Anterior - front or forward.
Arcuate - bent in a bow or arched.
Beak - the raised portion of the dorsal margin of a shell; formed by the embryonic shell around which the rest of the shell develops distally in a concentric manner.
Beak cavity - the cavity on the inside of each valve leading into the beak, under the interdentum.
Beak sculpture - raised ridges or undulations on the umbo.
Biangulate - having two angles.
Bradytictic - mussels which are long term breeders; females retain glochidia in their gills typically over the winter.
Byssus, byssal threads - a bundle of tough threads secreted by the byssal gland in the foot of a bivalve, used to anchor the bivalve to some hard substrate.
Cardinal teeth - teeth located between the lateral teeth in Corbiculidae and Sphaeriidae.
Chevron - shaped like a wide-angled V.
Clinal variation - the graded variation in morphology exhibited by a species in mollusks from headwater areas to the mouth of the highest order stream.
Compressed (subcompressed) - flattened out or pressed together.
Concentric - having a common center, such as ridges or loops radiating from the beak of a mussel valve.
Conspecific - pertaining to individuals or populations of the same species.
Corrugated - marked by wrinkles or ridges and grooves.
Crescentic - shaped like the figure of the crescent moon with a convex and a concave edge.
Decorticate - to remove the outer covering, in mollusks the epidermis.
Disc - the middle or central portion of the exterior of a valve; distinct from the posterior slope or other areas immediately adjacent to the margin of the valve.
Discoidal - round and flat like a disc.
Dorsal - the top or back; in mussels, the hinge area.
Edentulous - lacking both pseudocardinal and lateral teeth.
Effuse - spread out broadly.
Elliptical (subelliptical) - elongated, having the form of an ellipse.
Elongate - long or extended.
Emarginate - having a shallow notching at the margin.
Endangered - this status at the state level includes peripheral forms which may be common in another part of its range, but whose continued existence within the political boundaries of the state is in danger of extirpation. At the national level, this status means the organism is in danger of extinction, and included on or being considered for the U.S. List of Endangered Fauna and Endangered and Threatened Plant Species of the United States, under the Endangered Species Act of 1973 (Cooper et al. 1973:x).
Epidermis - exterior or outside (corneous) layer of the shell.
Extinct - a species which has no living representatives; all individuals are no longer extant.
Extirpated - the extinction of a species within a portion of its range.
Form - an animal with questionable taxonomic status; that is, one exhibiting variation but the extent or degree is not well enough known to determine whether it is a species, subspecies or simply individual or population variation.
Fusiform - tapering toward each end.
Gills - a thin plate-like paired structure within the mantle cavity which serves as a respiratory organ in aquatic mollusks and in female unionids all of the gills or certain portions of the gills serve as the marsupium.
Globose - globe-like, spherical.
Glochidium (plural - glochidia) - the bivalve larvae of unionids which are generally parasitic on the gills of fish.
Gravid female - a female which has embryos in the marsupium.
Growth lines - compact lines of temporarily arrested growth or rest periods appearing on the epidermis of the shell as a raised or darker concentric line.
Hinge ligament - an elastic, elongate, corneous structure that unites the two valves dorsally along the hinge plate.
Holotype - single specimen designated as the "type" by the author in the publication of a new species level taxon.

Inequilateral - in a bivalve, having the two ends unequal, i.e., one end is wider or thicker than the other.
Inflated (subinflated) - moderately to greatly inflated.
Interdentum - a flattened area of the hinge plate between the pseudocardinal and lateral teeth.
Iridescent - showing colors like those of a rainbow.
Lachrymose - term describing teardrop-shaped pustules.
Lateral teeth - the elongated, raised and interlocking structures along the hinge line of the valve.
Lectotype - one of a series of syntypes which, subsequent to the publication of an original description of a species level taxon, is selected (by publication) to serve as the type specimen for that taxon.
Lunule - depressed area immediately anterior to the umbo.
Marsupial swelling - a section of the posterior ventral margin of the female unionid shell which is enlarged or inflated to provide space for expansion of the marsupium with the development of the glochidia.
Marsupium (marsupial pouch) - in unionids, a brood pouch for eggs and developing glochidia, formed by a restricted portion of the outer gill, the complete outer gill or all four gills.
Muscle scar - the area of attachment of a muscle to the inside of the shell; e.g., the anterior adductor muscle scar is the location of attachment for the anterior adductor muscle.
Nacre - the interior iridescent, thin layer of a mussel shell.
Naiad - formerly a tribe of mollusca nearly equivalent taxonomically to the family Unionidae, often used as a synonym of unionid.
Nodule (subnodulous) - a small rounded mass of irregular shape.
Oblique - slanting; angled, but not horizontal or vertical.
Obovate - (subobovate) - ovate.
Orbicular (suborbicular) - having the form of an orb; circular or nearly circular in outline.
Oval, Ovate (subovate) - egg-shaped, broadly elliptical.
Pallial line - an indented groove or line approximately parallel with the ventral margin of a bivalve shell which marks the line of muscles attaching the mantle to the shell.
Paratype - each specimen of a type series other than the holotype designated in the original publication of the taxon.
Periphery - the external boundary on a surface, edge.
Periostracum - see epidermis.
Plications - parallel ridges on the surface of the shell.
Posterior - hind or rear.
Posterior ridge - a ridge on the exterior of a mussel shell, extending from the umbo to the posterior margin.
Posterior slope - the area across the dorsal portion of the valve extending from the umbo to the posterior margin, often above the posterior ridge.
Pseudocardinal teeth - triangular-shaped hinge teeth near the anterior -dorsal margin of the shell.
Pustule - small, raised structure on the external or outside surface of the shell (see also tubercle).
Quadrate (subquadrate) - square, or nearly square in outline.
Radial furrow - a groove or depression; in naiads a groove running from the umbo area toward the shell margin.
Radiating - proceeding outward from a central point.
Rare- seldom appearing, occurring widely separated in space; extremely few in number.
Rectangular - a shape with four sides possessing four right-angles.
Rest mark - see growth lines.
Rhomboid (subrhomboid) - having generally four distinct sides, two sides being longer than the others.
Semicircular - a partial or incomplete circle.
Serrated - notched or grooved.
Sexual dimorphism - a condition in which males and females of the same species are morphologically different, usually indicated by an expanded posterior marsupial area in the female in contrast to a more pointed or bluntly rounded area in the male.
Sinus - a character of some unionids which have a depression above or below the posterior ridge.
Solid (subsolid) - shells which are thick and heavy.
Special Concern - This status covers cases where the organism exists in small populations over a broad range, may be over exploited which may pose a threat, the organism are especially vulnerable to specific pressures, or any other reasons identified by experienced researchers (Cooper et al. 1973:x).
Species - group of interbreeding natural populations that are reproductively isolated from all other such groups.
Striae - impressed or raised lines on a shell.

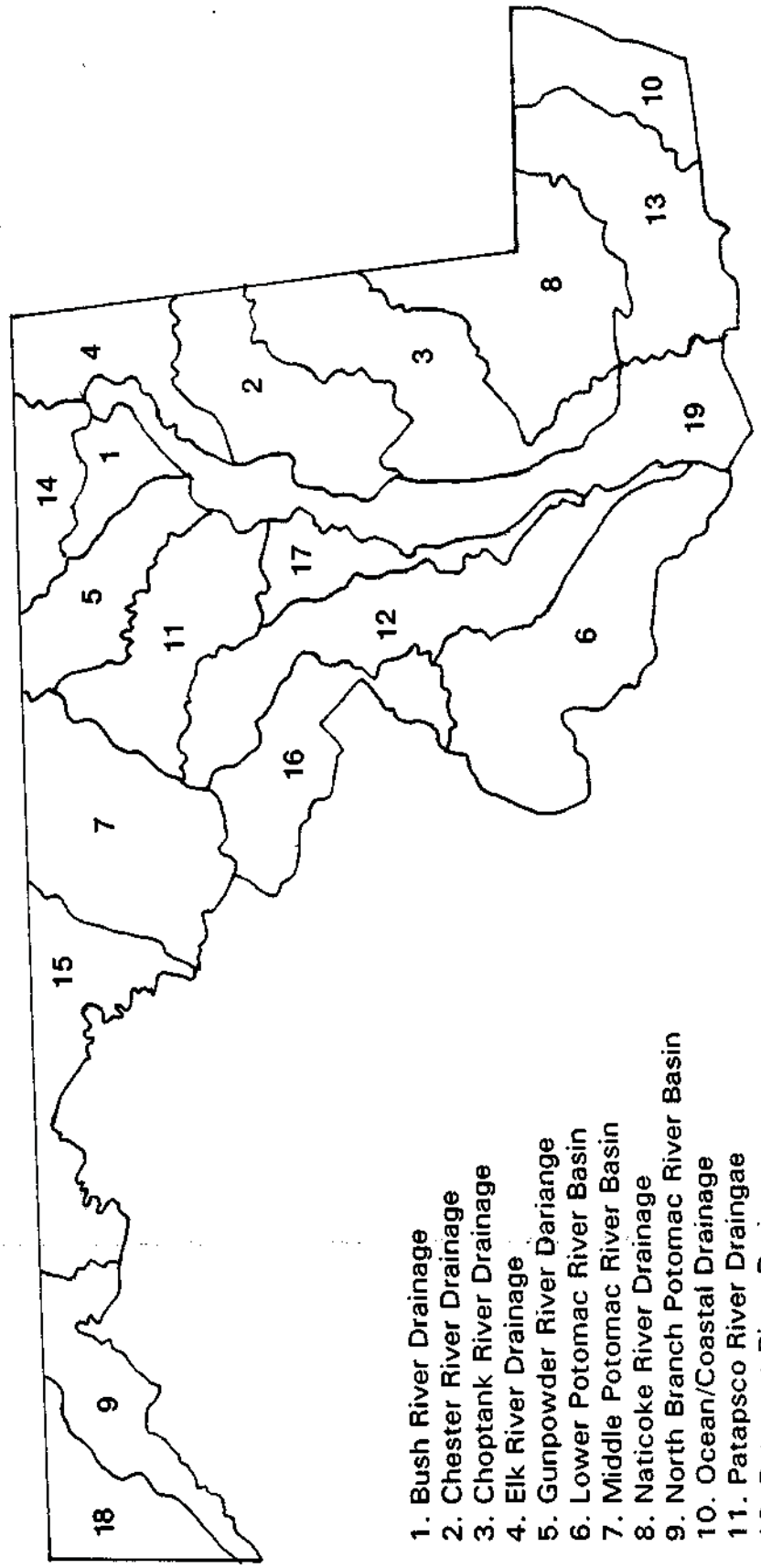
Striate - having striae.
Subspecies - a geographically defined aggregate of local populations within a species which differ morphologically and/or physiologically from other aggregations of local populations within that species.
Sulcus (plural - sulci) - a longitudinal furrow or depression.
Sympatric - pertaining to populations of two or more closely related species which occupy identical or broadly overlapping geographical areas.
Syntype - one of a series of specimens of the same taxon which formed the material studied by the original author to describe a new species level taxon, form which no type specimen (holotype) was designated.
Tachytictic - mussels which are short-term breeders; i.e., glochidia are found in the gills of the female only during the summer.
Taxon - any formal taxonomic unit or category of an organism; e.g., a species or genus.
Threatened - This status at the state level includes forms which are likely to become Endangered in the foreseeable future if certain conditions are not met. This includes forms which exhibit a considerable decrease in numbers beyond normal populations fluctuations or a documented range contraction, but are not yet considered Endangered. At the national level this applies to the Endangered Species Act of 1973 (Cooper et al. 1973:x).
Trapezoid (subtrapezoid) - a shape having four distinct sides with two sides parallel.
Triangular (subtriangular) - a shape having three sides and three angles, like a triangle.
Truncate (subtruncate) - having the end squared off.
Tubercle (tuberculate) - small, raised, rounded knob on the outside of the shell.
Tuberculate - having tubercles on the outside of the shell.
Type - a designated specimen or specimens of an organism that serves as the basis for the original name and description of any species level taxon.
Umbo/umbone - the dorsally raised, inflated area of the bivalve shell.
Unionids - refers to any member of the freshwater bivalve mollusks which belong to the superfamily Unionoidea.
Undulation - pattern with waves; raised ridges or bars.
Valve - the right or left half of a mussel (or unionid) shell.
Ventral - the underside or bottom.

The following volumes, in addition to *Webster's Unabridged Dictionary*, were used to compile the definitions used in the glossary.

Burch, John B. 1962. *How to know the eastern land snails*, Pictured Key Nature Series, Wm. C. Brown Company Publishers, Dubuque, Iowa, 214 pp. 519 fig.
Burch, John B. 1975. *Freshwater Unionacean Clams (Mollusca: Pelecypoda) of North America.* Malacological Publications, Hamburg, Michigan, 204 pp. 252 fig.
Leonard, A. Byron. 1954. Handbook of Gastropods in Kansas. *University of Kansas Museum of Natural History Miscellaneous Publication* No. 20, pp. 1-224, 22 pl.
Murray, Harold D. and A. Byron Leonard. 1962. Handbook of Unionid Mussels in Kansas, *University of Kansas Museum of Natural History Miscellaneous Publication* No. 28, pp. 1-184, 45 pl. 42 fig.
Parmalee, Paul W. 1967. The Freshwater Mussels of Illinois. *Illinois State Museum, Popular Science Series*, Vol. 8, pp 108, 35 pl. 4 fig.
Pennak, Robert W. 1964. *Collegiate dictionary of zoology*, The Ronald Press Company, New York. 583 pp.

This glossary was taken from Bogan (1993).

Map 1. Eighteen Major Drainage basins of Maryland (adapted from printout from Maryland Department of Natural Resources)



List of families/superfamilies of freshwater bivalves occurring Maryland including the higher molluscan classification.

Phylum Mollusca

Class Bivalvia

Subclass Paleoheterodonta

Order Unionoida
Superfamily Unionoidea

Family Unionidae [10 genera, 17 species] (see page 11 for species list)
Alasmidonta [4 species]
Anodonta [1]
Elliptio [3]
Lampsilis [3]
Lasmigona [1]
Leptodea [1]
Ligumia [1]
Pyganodon [1]
Strophitus [1]
Utterbackia [1]

Subclass Heterodonta

Order Veneroida
Superfamily Dreissenoidea
Family Dreissenidae
Dreissena [Zebra mussel, quagga mussel] **Not yet known from Maryland!**

Superfamily Corbiculoidea
Family Corbiculidae
Corbicula fluminea (Müller, 1774) [Asian clam]

Family Sphaeriidae [fingernail clams or pillclams] (3 genera, 20 species; see page 11)
Musculium [4]
Pisidium [12]
Sphaerium [4]

List of unionid bivalves of Maryland with common and scientific names and status

Species	Common Name[1]	Status *	X	E	S
Alasmidonta heterodon (Lea, 1829)	dwarf wedgemussel	*		E	
Alasmidonta marginata susquehannae Ortmann, 1919	Susquehanna elktoe		?		
Alasmidonta undulata (Say, 1817)	triangle floater			E	
Alasmidonta varicosa (Lamarck, 1819)	brook floater		X	E	
Anodonta implicata Say, 1829	alewife floater				
Elliptio angustata (Lea, 1831)	Carolina lance			E	
Elliptio complanata (Lightfoot, 1786)	eastern elliptio				
Elliptio fisheriana (Lea, 1838)	northern lance				S
Lampsilis cardium Rafinesque, 1820	plain pocketbook				
Lampsilis cariosa (Say, 1817)	yellow lampmussel			E	
Lampsilis radiata (Gmelin, 1791)	eastern lampmussel				
Lasmigona subviridis (Conrad, 1835)	green floater			E	
Leptodea ochracea (Say, 1817)	tidewater mucket				
Ligumia nasuta (Say, 1817)	eastern pondmussel				
Pyganodon (=Anodonta) cataracta (Say, 1817)	eastern floater				
Strophitus undulatus (Say, 1817)	squawfoot				
Utterbackia (=Anodonta) imbecillis (Say, 1829)	paper pondshell				

List of sphaeriidae of Maryland with common and scientific names (Gerberich, 1984).

Species	Common Name	Status *	X	E	S
Musculium lacustre (Müller, 1774)	lake fingernailclam				
Musculium partumeium (Say, 1822)	swamp fingernailclam				
Musculium securis (Prime, 1852)	pond fingernailclam				
Musculium transversum (Say, 1829)	long fingernailclam				
Pisidium adamsi Stimpson, 1851	Adam peaclam				
Pisidium casertanum (Poli, 1791)	ubiquitous peaclam				
Pisidium compressum Prime, 1852	ridged-beak peaclam				
Pisidium dubium (Say, 1817)	greater eastern peaclam				
Pisidium equilaterale Prime, 1852	round peaclam				S
Pisidium fallax Sterki, 1896	river peaclam				
Pisidium ferrugineum Prime, 1852	rusty peaclam				
Pisidium lilljeborgi (Clessin, 1886)	Lilljeborg peaclam				
Pisidium nitidum Jenyns, 1852	shiny peaclam				
Pisidium punctatum Sterki, 1895	perforated peaclam				
Pisidium variable Prime, 1852	triangular peaclam				
Pisidium walkeri Sterki, 1895	Walker peaclam				
Sphaerium fabale (Prime, 1852)	river fingernail clam				
Sphaerium occidentale (Lewis, 1856)	Herrington fingernailclam				
Sphaerium simile (Say, 1817)	grooved fingernailclam				
Sphaerium striatinum (Lamarck, 1818)	striated fingernailclam				

* federally endangered
X presumed extinct in Maryland
E suggested as endangered in Maryland
S suggested as special concern in Maryland
[1] Common names follow Turgeon et al. (1988)

KEY TO THE SHELLS OF THE FRESHWATER BIVALVES OF MARYLAND (1/97 update)

1 a. Shell with very sharp posterior ridge, shaped like a marine mussel, *Mytilus*, generally less than 30 millimeters, and attached to a hard substrate with byssal threads (fig.2) .....***Dreissena polymorpha***
Note: (nonindigenous aquatic nuisance species, not-found in wild in Maryland)

b. Animal without byssal threads attaching adult animal to substrate, with or without teeth but not with above shape.....2

2 (1b) a. Valves with cardinal teeth and two sets of lateral teeth.....3

b. Valves with one set of lateral teeth and pseudocardinal teeth or without teeth (Unionidae).....4

3 (2a) a. Valves with serrated lateral teeth (fig. 3), nonindigenous species.....***Corbicula fluminea***

b. Valves with smooth lateral teeth.....**Sphaeriidae**

4 (2b) a. Specimens from the Ohio basin.....**Appendix A**

b. Specimens from the Chesapeake or coastal basins.....5

5 (4b) a. Hinge teeth absent.....6

b. Hinge teeth present..... 9

6 (5a) a. Beaks not projecting above the hinge line (ifg.20).....***Utterbackia imbecillis***

b. Beaks projecting above the hinge line.....7
1 (footnote)

7 (6b) a. Beak sculpture double looped[1].....8

b. Vestige of pseudocardinal teeth usually represented by a thickening near the beaks (fig.19); nacre usually orange in the beak cavity, beak sculpture concentric .....***Strophitus undulatus***

8. (7b) a. Shell prominently thickened along the anterior third of the ventral margin of the shell below the pallial line, nacre salmon or copper colored (fig. 8) .....***Anodonta implicata***

b. Ventral margin of shell uniformly thin, nacre bluish or white, greenish epidermis (fig.18).....***Pyganodon cataracta***

9 (5b) a. Lateral teeth well developed, functional and interlocking.....12

b. Lateral teeth absent or reduced, neither functional nor interlocking.....10

10 (9b) a. Fine transverse ridges present on the posterior slope, pseudocardinal teeth reduced and elongate, with smooth surfaces.....11

b. Transverse ridges on posterior slope absent, pseudocardinal teeth strong and triangular, with rough surfaces, shell small to medium size, triangular to ovate (fig.6).....

.....***Alasmidonta undulata***

11(10a) a. Posterior ridge angular and prominent, shell truncated, color of posterior margin lighter than rest of shell (fig.5).....***Alasmidonta marginata susquehannae***

b. Posterior ridge rounded, shell rounded and usually less than 70 mm long (fig.7) .....***Alasmidonta varicosa***

12 (9a) a. Right valve with two lateral teeth, rare (fig.4).....***Alasmidonta heterodon***

b. Right valve with one lateral tooth.....13

13 (12b) a. Height/length ratio less than or equal to 0.5 shell elongate.....14

b. Height/length ratio greater than 0.5.....15

14 (13a) a. Posterior ridge prominent, posterior end of shell subangular; pseudocardinal teeth thin, bladelike, some shells with prominent rays, shell usually less than 110 mm in length (fig. 17).....***Ligunia nasuta***

b. Dark brown periostracum posterior ridge rounded, posterior end bluntly rounded, ventral margin broadly rounded lacks rays (fig.11),most commonly distributed lanceolate species on Maryland's Eastern Shore..... .....***Elliptio fisheriana***

c. Posterior ridge rounded, posterior end bluntly rounded, ventral margin broadly rounded lacks rays (fig.11), most commonly distributed anceolate species in Potomac drainage and Central part of state. ....***Elliptio producta***

d .Posterior ridge rounded, posterior end bluntly rounded, ventral margin broadly rounded lacks rays (fig.11), periosracum waxy, ranging from green to yellow.....***Elliptio lanceolata***

e. Shell elongate, with a well-defined posterior ridge, posterior end bluntly pointed, ventral margin straight (fig. 9).....***Elliptio angustata***

15 (13b) a. Nacre purple, may grade to a salmon color, shell subrhomboid with well-defined posterior ridge and slope, very common (fig.10) periostracum yellowish green to black.....***Elliptio complanata***

b. Nacre white or colored but not purple.....16

16(15b) a. Left valve with small interdental tooth, giving the appearance of three pseudocardinal teeth, shell more or less compressed and subrhomboid in outline, periosracum dark green with numerous green rays or brown, adult shell less than 65 mm long, posterior ridge rounded, beak sculpture is prominent raised bars (fig.15)..... .....***Lasmigona subviridis***

b. Left valve without interdental tooth, valve appears to have only two pseudocardinal teeth.....17

17(16b) a. Adult shell usually less than 80 mm in length, and thin, hardly thicker anteriorly than posteriorly, periostracum dull yellow without rays or with fine rays all over the shell, in or near tidewaters, nacre often a salmon color (fig.16).....***Leptodea ochracea***

b. Adult shell often greater than 80 mm in length, much thicker anteriorly than posteriorly, may have obvious broad color rays.....19

18 (17b) a. Over 1.5 times as long as high. Height/length less than 0.60 mm or cm in males and in most females, shell with rays all over the shell (may be obscured in old adults), posterior ridge low and broadly rounded, beaks not prominent (fig. 14)..... .....***Lampsilis radiata***

b. Height/length greater than 0.60, mm or cm beaks prominent, periostracum yellow to light brown now bluish white..... 20

19 (18b) a. Periostracum glossy yellow reddish brown in adults. Green rays if present are very thin and restricted to the posterior slope, posterior ridge very smooth and rounded psuedocardinal teeth are both serrated and perpendicular to the hinge line ,psuedocardinal teeth on left valve are perpendicular to hinge line. (fig.13).....***Lampsilis cariosa***

b. Periostracum yellow to yellowish-brown, sometimes marked with distinct dark green rays, which can be thicker than those in *L. cariosa* (indistinct in old shells), shell globose, almost as high as long, posterior ridge rounded, beaks very inflated (fig.12) nacre silver white and pink under beak, psuedocardinal teeth on left valve are parallel to hinge line, nonindigenous species, introduced into the Potomac River..... ***Lampsilis cardium***[3]

[1]Beak sculpture is often difficult to evaluate, as a result of shelf erosion, in all but very small specimens.

[2]There are taxonomic problems with the group of lanceolate species in the genus *Elliptio*. Several names have been used for this group on Maryland including *E. fisheriana* (Lea 1838), *E. producta* (Conrad, 1836) and *E. angustata* (Lea, 1831). The last two species were described from the Savannah River in South Carolina and Georgia and the Cooper and Congaree rivers in South Carolina, respectively. *E. fisheriana* (Lea, 1838) was described from the "head of Chester River, [Kent Co.] Maryland." There is confusion as to what constitutes a species and where one ends and the next begins. *E. angustata* was described first so probably should be the name used for this shell shape until this species complex is resolved. *E. producta* has also been described in Maryland.

[3]The inclusion of *Lampsilis ovata* (Say, 1817) on the list of species for Maryland is in error. It stems from the placement of the subspecies Ortmann described, *ventricosa cohongoronta* Ortmann, 1912, from the Potomac River. The confusion is a result of some people using *ventricosa* (Barnes, 1823) as either a subspecies or junior synonym of *L. ovata*, it is not. *Cardium* Rafinesque, 1820 is an earlier name and senior synonym for *ventricosa* (Barnes, 1823).

List of Institutions with major unionid collections, address and contact person.

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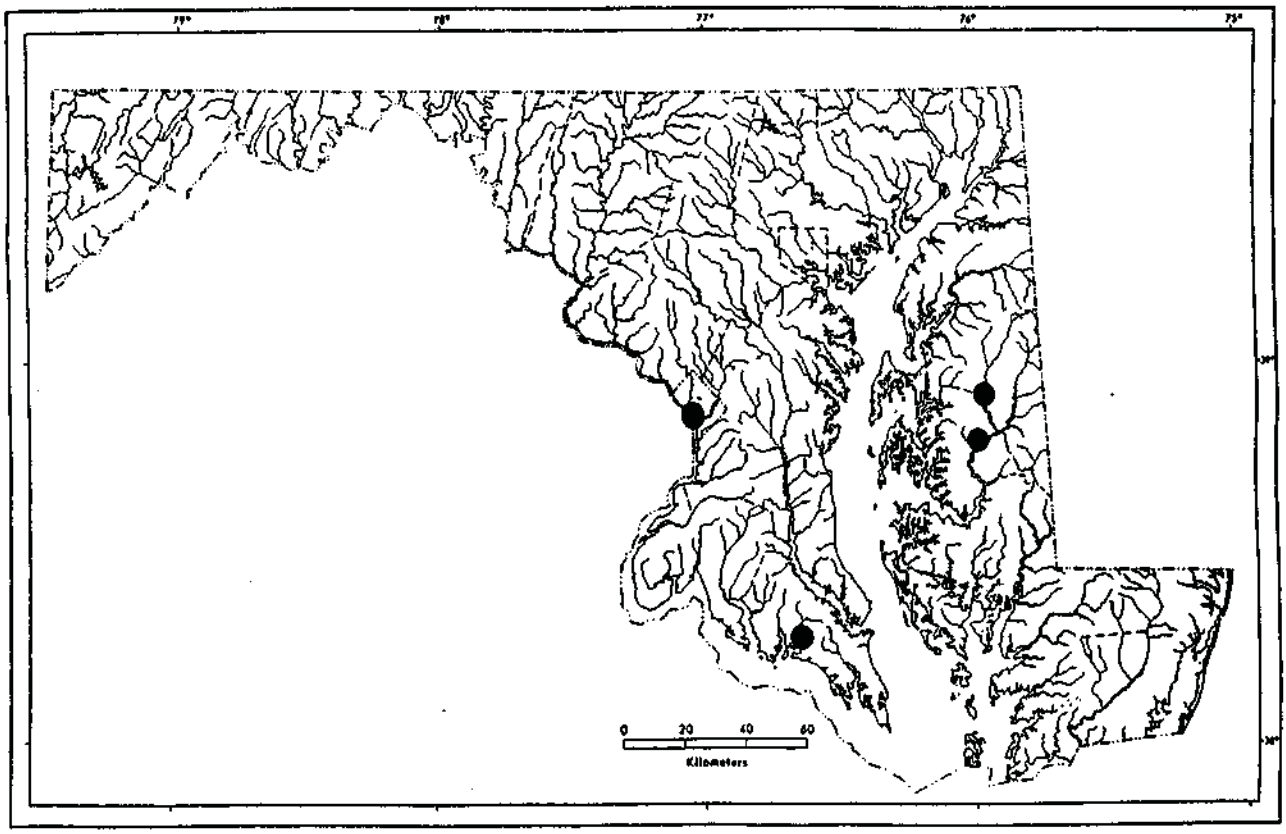
University of Florida
Gainesville, FL 32611



Map 2 Distribution of *Alasmidonta heterodon* (Lea, 1829) in Maryland.

Alasmidonta heterodon (Lea, 1829) **dwarf wedgemussel** Fig. 4

SYNONYMY.

Unio heterodon Lea, 1829
Alasmidonta heterodon (Lea, 1829)
Alasmidonta (*Pressodonta*) *heterodon* (Lea, 1829)

SHELL DESCRIPTION. Shell small, subtrapezoid or "hump backed" shell thick anteriorly and thinning posteriorly, ventral margin mostly straight, posterior margin pointed near the base, dorsal margin slightly curved, beaks low and rounded, projecting only slightly above the hinge line, posterior ridge rounded, somewhat inflated and prominent, periostracum yellowish, olive brown to blackish with variable width reddish brown rays, hinge teeth unusual with an interdental projection, beak cavity narrow and rather shallow, nacre bluish white.

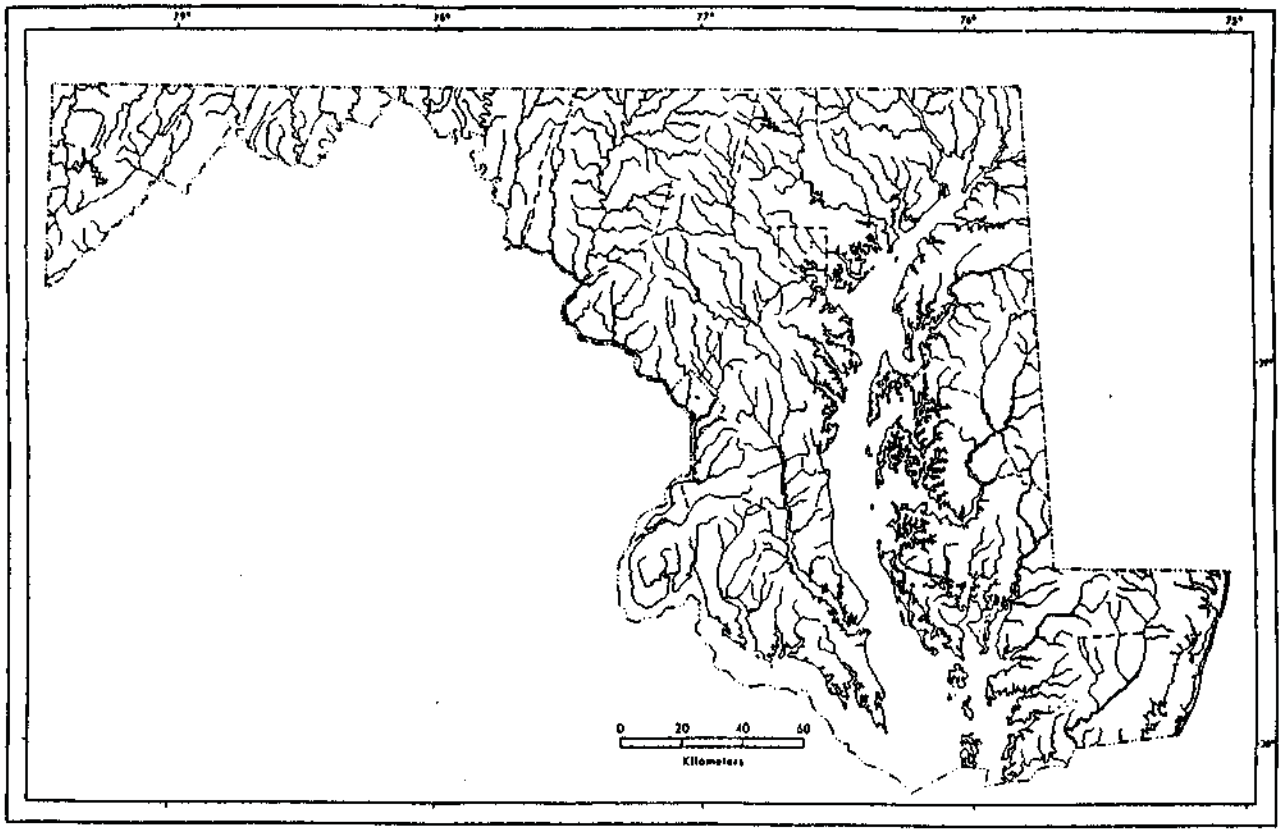
DISTRIBUTION. Connecticut, Delaware, Massachusetts, Maryland, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Virginia, Vermont, Canada: New Brunswick (Williams et al. 1993).

ECOLOGY. Ortmann (1919:176) observed " I found this species in very small streams ("runs"), in strongly flowing water, and in rather coarse gravel, ... in a small branch of the river in sand and moderate current ... in the canal at Manayunk at time when the water had been drained off ... Here the bottom consisted of larger and smaller stones, the interstices filled with sandy mud. This however, cannot be regarded as normal, and the ecological conditions of this species remain to be studied."

BREEDING SEASON. Ortmann (1919:174) reported gravid females from February to April.

HOST FISH. Unknown (Watters 1994).

STATUS. Federally endangered

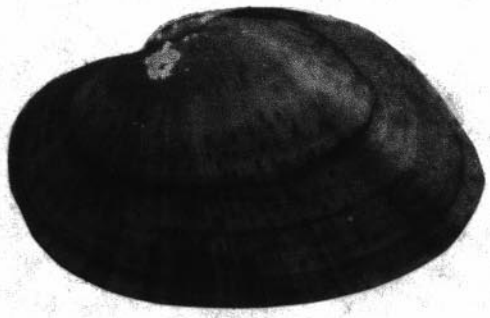


Map 3 Distribution of *Alasmidonta marginata susquehannae* Ortmann, 1919 in Maryland. Not reported historically from Maryland.

Alasmidonta marginata susquehannae Ortmann, 1919 **Susquehanna elktoe** Fig. 5

SYNONYMY.

Alasmidonta marginata Say, 1818
Alasmidonta marginata Say, 1818
Mya rugulosa Wood, 1828
Alasmodon (Decurambis) scriptum Rafinesque, 1831
Unio swanaonensis Hanley, 1842
Alasmidonta corrugata DeKay, 1843
Margaritana marginata "var. *truncata*" B.H. Wright, 1898
Alasmidonta (Decurambis) marginata susquehannae Ortmann, 1919
Alasmidonta marginata variabilis F.C. Baker, 1928
Alasmidonta (Decurambis) marginata Say, 1818



SHELL DESCRIPTION. Shell elongated, dorsal margin gently rounded, ventral margin nearly straight, anterior end rounded, shell inflated, relatively thin, posterior ridge sharp and prominent, posterior slope broad, flat and often covered with fine flutings beak sculpture heavy double-looped ridges, periostracum yellowish brown often a rusty color, numerous green rays with dark green spots, pseudocardinal teeth elongate, lateral teeth reduced to a swelling, beak cavity open and moderately deep, nacre color bluish white often with a tinge of salmon.

DISTRIBUTION: Maryland, New York, Pennsylvania, (Williams et al. 1993)

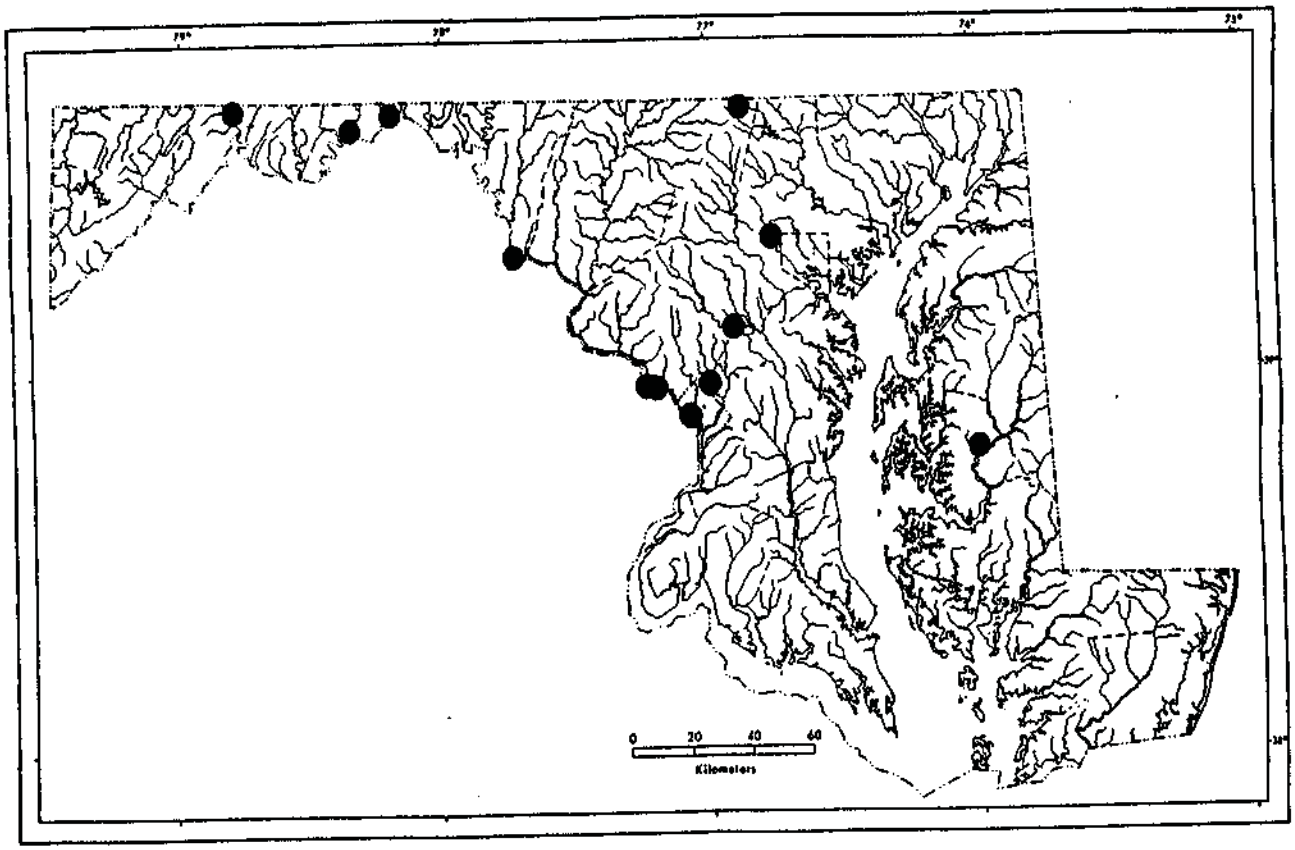
ECOLOGY. Ortmann (1919:186) reported the ecology of *Alasmidonta marginata* from the Interior Basin as "most decidedly a species of the riffles, being found there in finer or coarse, but firmly packed gravel in swift currents. ... Call (1900) remarks on the strongly developed foot of this species ... When fully extended, the foot is firmly attached to the gravel in the river bed, and it requires quite an effort to dislodge the specimens." He noted that the subspecies in the Susquehanna River Basin " frequents riffles, and this renders it the more conspicuous, since there are few species on the Atlantic side which *prefer* this habitat." (Ortmann 1919:190).

BREEDING SEASON. Ortmann (1919:188) reported eggs and glochidia in August and noted that the species is probably bradytictic.

HOST FISH. Watters (1994:97) lists the following species as host fish for *Alasmidonta marginata*: northern hogsucker, *Hypentelium nigricans*; shorthead redhorese, *Moxostoma macrolepidotum*; white sucker, *Catostomus commersoni*, rock bass, *Ambloplites rupestris*, warmouth, *Lepomis gulosus*. No mention is made of the host fish for the Atlantic Slope subspecies.

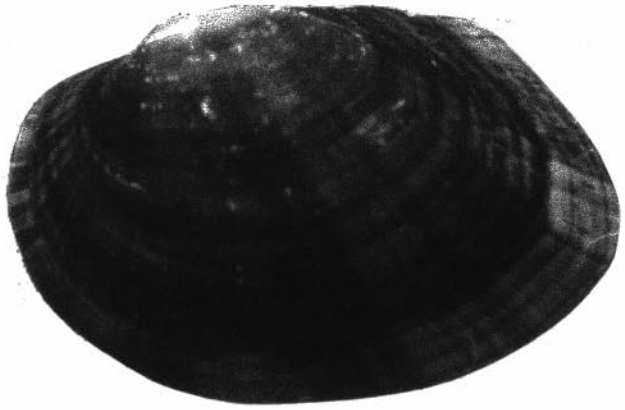
STATUS. Special concern (Williams et al. 1993).

COMMENTS: Gerberich (1984) noted that this taxon has not been reported from Maryland, but it probably occurred historically in the main channel of the Susquehanna River in Maryland.



Map 4 Distribution of *Alasmidonta undulata* (Say, 1817) in Maryland.

Alasmidonta undulata (Say, 1817) **triangle floater** Fig. 6.



SYNONYMY

Unio undulata Say, 1817
"*Unio glabratus?* Lamarck" Sowerby, 1823
Unio hians Valenciennes, 1827
Alasmidonta sculptilis Say, 1829
Uniopsis radiata Swainson, 1840
Uniopsis mytiloides Swainson, 1840
Margaritana triangulata Lea, 1858
Unio swainsoni Sowerby, 1868
Alasmidonta (Alasmidonta) undulata (Say, 1817)

SHELL DESCRIPTION. Shell ovate to triangular, shell thickened and strong anteriorly becoming thin posteriorly, ventral margin evenly rounded, posterior margin rounded and pointed ventrally, beak somewhat inflated and located in the anterior third of the shell, posterior ridge well marked and rounded, posterior slope of adults with a few low coarse ridges, periostracum smooth and shiny, yellowish with green rays, background becoming brownish to black in adult specimens, pseudocardinal teeth stumpy, interdental projection well developed in left valve, nacre white and some with salmon or pink.

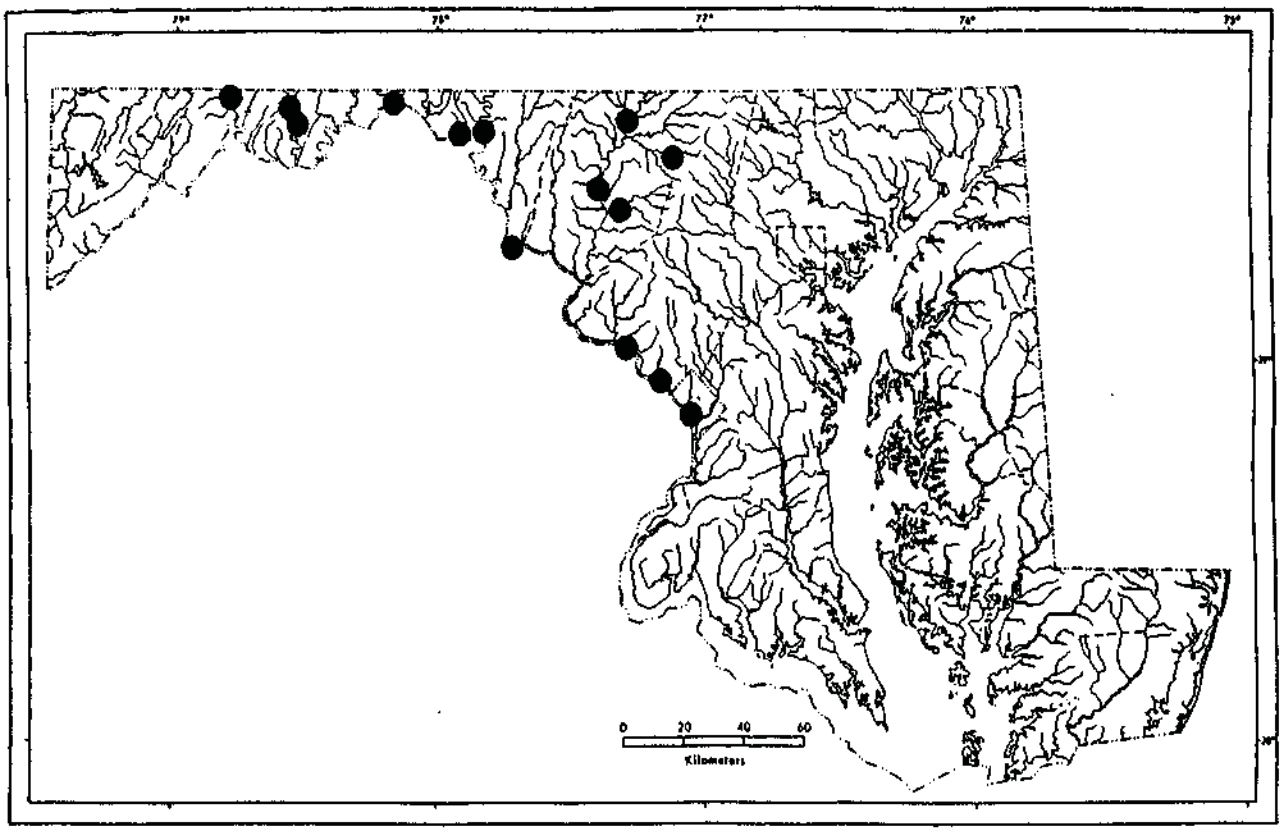
DISTRIBUTION: Alabama, Connecticut, Delaware, Florida, Georgia, Massachusetts, Maryland, Maine, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, West Virginia, New Brunswick, Nova Scotia, Ontario, Quebec, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:180) noted this species "it is quite evident that it avoids the larger rivers, and prefers the smaller streams, where it becomes locally very abundant, going far up towards the headwaters, ... It does not seem to favor riffles and very rough water, but is found chiefly in more quiet parts, but with some current, for instance, above riffles, where a steady flow of water prevails. It does not like slackwater, but occasional it is found in ponds and canals; .. It also like mill-races, if the current is not too rapid. It lives mostly in a mixture of coarser or finer gravel with sand and mud; but I have taken it also in eddies with slow current embedded in the mud deposited between larger stones."

BREEDING SEASON. Ortmann (1919:178) reported gravid females July to September and April to June, a bradytictic species.

HOST FISH. Unknown (Watters 1994).

STATUS. Special concern (Williams et al. 1993).



Map 5 Distribution of *Alasmidonta varicosa* (Lamarck, 1819) in Maryland.

Alasmidonta varicosa (Lamarck, 1819) **brook floater** Fig. 7.

SYNONYMY.

Unio varicosa Lamarck, 1819
Alasmodon corrugata DeKay, 1843
Alasmidonta (*Decurambis*) *varicosa* (Lamarck, 1819)
Mya rugulosa Wood, 1856

SHELL DESCRIPTION. Shell kidney shaped, thin shelled, slightly thicker anteriorly, ventral margin straight and slightly concave centrally, beaks narrow and bluntly pointed, posterior ridge broad, flat and inflated, posterior slope flattened to slightly concave, often with poorly developed corrugations, periostracum yellowish and partly to completely covered with green rays, hinge teeth poorly developed to rudimentary, interdental projection well defined or a small swelling, beak cavity open and shallow, nacre bluish to bluish white, tan to olive or pinkish in the beak cavity.

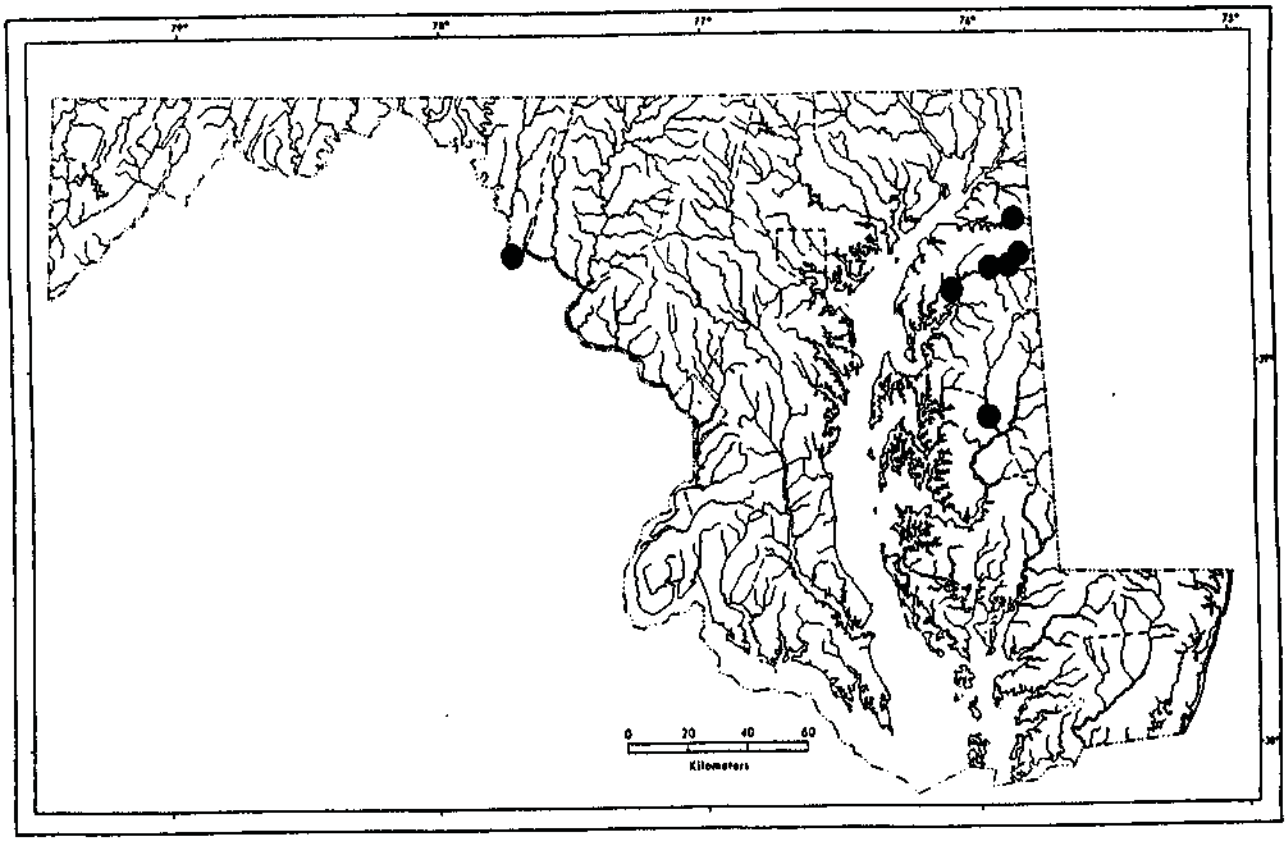
DISTRIBUTION: Connecticut, Delaware, Georgia, Massachusetts, Maryland, Maine, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, West Virginia, New Brunswick, Nova Scotia, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:193) noted " In the smaller streams this species is more abundant, and locally common. ... it is distinctly a shell which prefers strong currents and gravelly bottoms, thus being most frequently found in and near riffles ... it goes far up into the headwaters."

BREEDING SEASON. Ortmann (1919:191-192) observed eggs in the marsupium in August, glochidia in September and discharge of glochidia in May. The species is bradytictic.

HOST FISH. Unknown (Watters 1994).

STATUS. Threatened (Williams et al. 1993).



Map 6 Distribution of *Anodonta implicata* Say, 1829 in Maryland.

Anodonta implicata Say, 1829 **alewife floater** Fig. 8.

SYNONYMY.

Anodonta implicata Say, 1829
Anodonta newtonensis Lea, 1836
Anodonta housatonica Linsley, 1845
Anodonta (Pyganodon) implicata Say, 1829

SHELL DESCRIPTION. Shell elongate-elliptical to elongate ovate, valves quite inflated, subcylindrical, valves thick for *Anodonta*, ventral margin straight, dorsal margin straight, posterior ridge rounded and biangulate, umbos somewhat swollen and located in anterior third of shell, beak sculpture is 5 to 7 double looped bars, periostracum smooth, yellowish brown, greenish brown to reddish brown and black with age, immature specimens have fine rays, no teeth, beak cavity shallow, shell distinctly thickened along the anterior ventral margin below the pallial line, nacre color pale copper, pinkish or white.

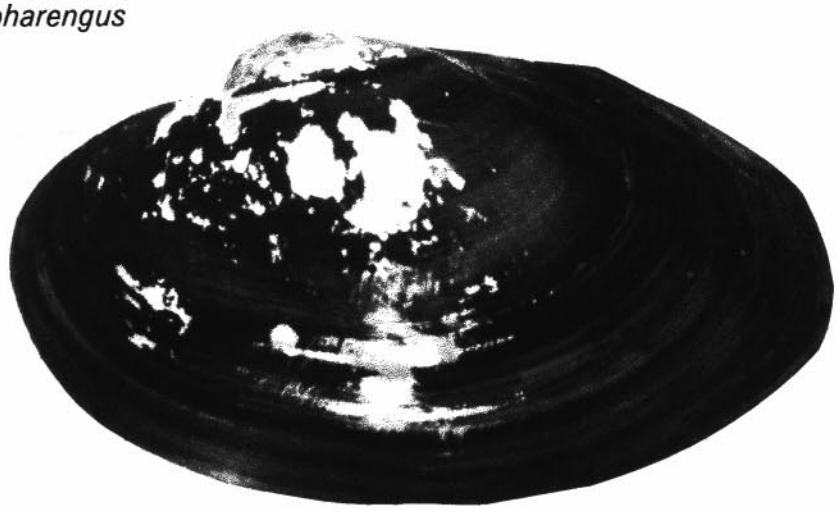
DISTRIBUTION: Connecticut, Delaware, Massachusetts, Maryland, Maine, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, New Brunswick, Nova Scotia, Quebec, Canada (Williams et al. 1993).

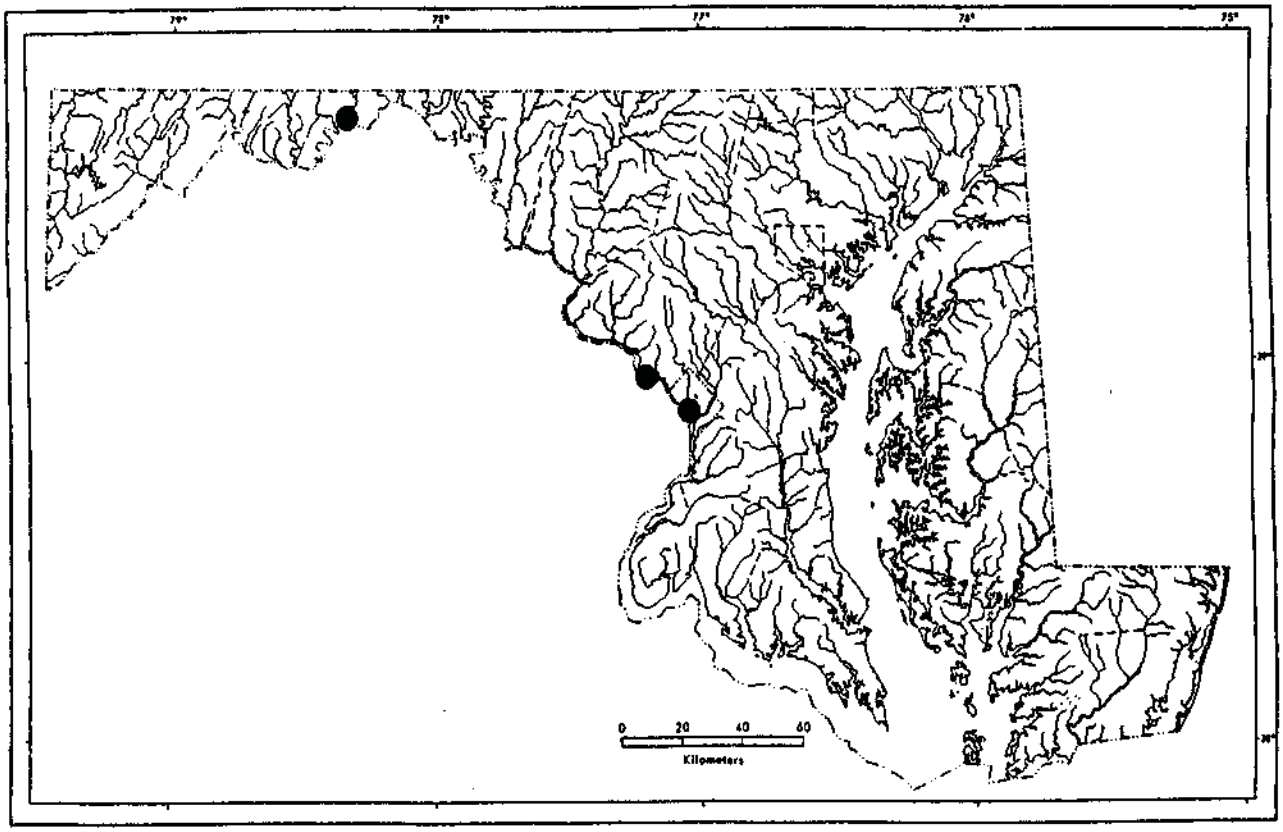
ECOLOGY. Ortmann (1919:162) reported the ecology of this species as: "Generally it is reported as living in ponds, but sometimes also in rivers."

BREEDING SEASON. Ortmann (1919:160) reported the breeding season as September to May, a bradytictic species.

HOST FISH. Watters (1994:101) lists the following species as host fish for *Anodonta implicata*: alewife, *Alosa pseudoharengus* (Wilson, 1811).

STATUS. Currently stable (Williams et al. 1993).



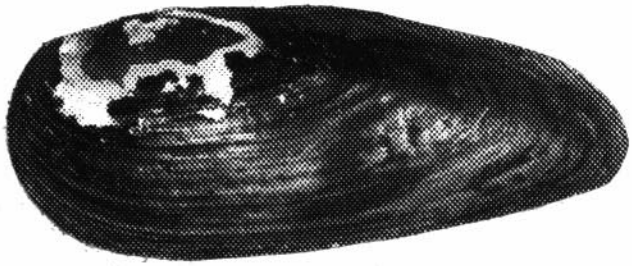


Map 7 Distribution of *Elliptio angustata* (Lea, 1831) in Maryland.

Elliptio angustata (Lea, 1831) **Carolina lance** fig. 9

SYNONYMY.

Unio angustatus Lea, 1831



SHELL DESCRIPTION. The shell is elongated, subrhomboid or subelliptical, subcompressed to slightly inflated, the valves are thin to subsolid, the beaks are scarcely inflated or elevated and their sculpture is a series of strong ridges nearly parallel with the growth lines. The posterior ridge is well developed, angulated and more or less double. Posterior margin bluntly pointed and ventral margin straight. The epidermis is olive in juveniles becoming nearly black in older individuals and the surface is rather dull. The pseudocardinal teeth are compressed and double in both valves, the upper one in the right valve is small. The lateral teeth are long, somewhater club-shaped. Adductor muscle scars are shallow. Nacre color is purplish brown (after Simpson 1914:678).

DISTRIBUTION: Georgia, Maryland, North Carolina, South Carolina, Virginia (Williams et al. 1993).

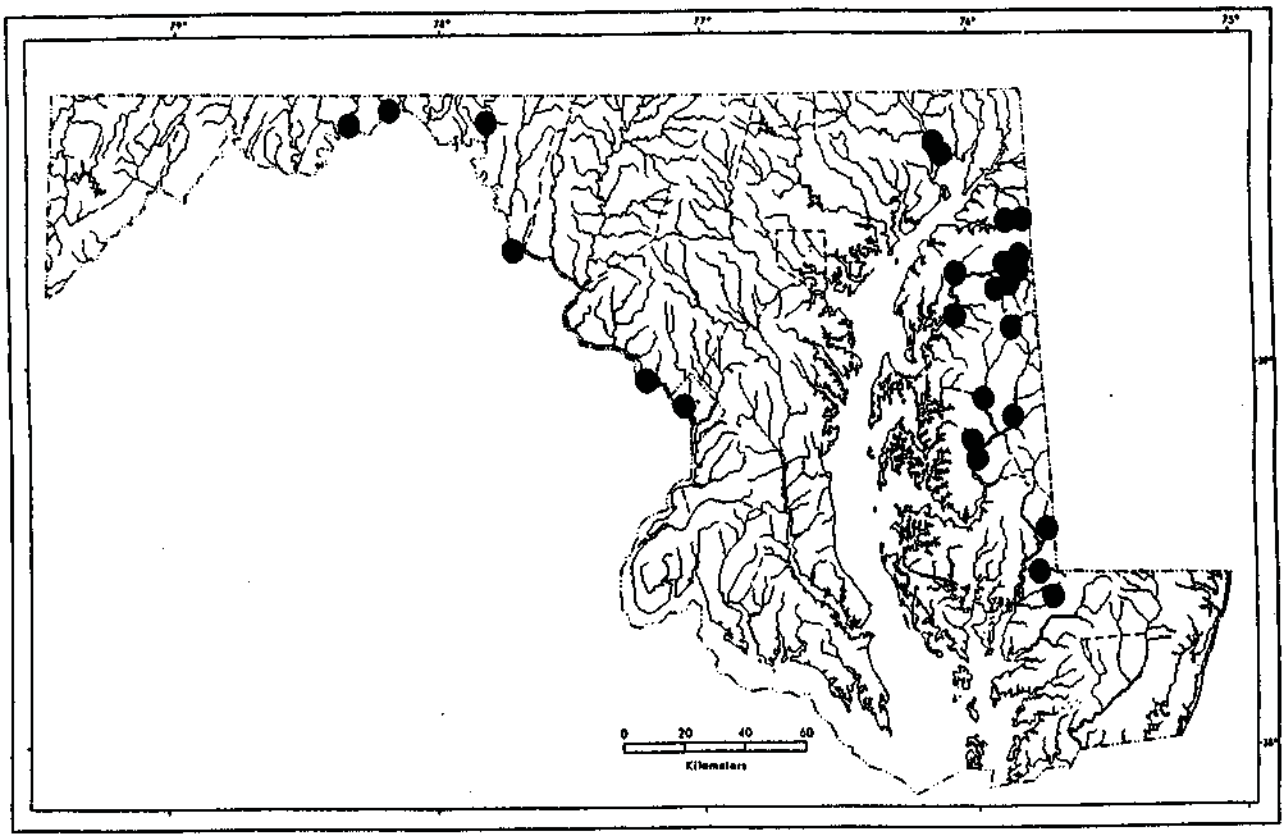
ECOLOGY. Ortmann (1919:113) noted "I found it either in gravel, or among larger rocks, in mud-filled interstices, but generally not in strong current, but in quiet coves and eddies. It also seems to prefer the smaller streams to the larger rivers."

BREEDING SEASON. Ortmann (1919:111) listed gravid females from early May to early June (this species listed as *Elliptio cupreus*).

HOST FISH. Unknown (Watters 1994).

STATUS. Special concern (Williams et al. 1993).

COMMENTS. There is much confusion regarding the lanceolate *Elliptio* of the middle Atlantic Slope drainages. Lea described numerous species which were subsequently all lumped under *Elliptio lanceolata* (Lea, 1828). Two names have been used for the second lanceolate species *Elliptio producta* (Lea, 1836) described from the Savannah River in Georgia and *Elliptio angustata* (Lea, 1831) described from the Cooper River in South Carolina.



Map 8 Distribution of *Elliptio complanata* (Lightfoot, 1786) in Maryland.

Elliptio complanata (Lightfoot, 1786) **eastern elliptio** Fig. 10

SYNONYMY.

Mya complanata Lightfoot, 1786
Unio violaceus Spengler, 1793
Unio purpureus Say, 1817
Unio rarisulcata Lamarck, 1819
Unio coarctata Lamarck, 1819
Unio purpurascens Lamarck, 1819
Unio rhombula Lamarck,1819
Unio carinifera Lamarck, 1819
Unio georgina Lamarck, 1819
Unio glabrata Lamarck, 1819
Unio sulcidens Lamarck, 1819
Unio virginiana Lamarck, 1819
Unio aurata Rafinesque, 1820
Unio fluviatilis Green, 1827
Mya rigida Wood, 1828
Unio griffithianus Lea, 1834
Unio complanatus subinflatus Conrad, 1835
Unio jejunus Lea, 1838
Unio fuliginosus Lea, 1845
Unio cuvierianus Lea, 1852
Unio errans Lea, 1856 good species ????
Unio vicinus Lea, 1856
Unio geminus Lea, 1856
Unio abbevillensis Lea, 1857
Unio percoarctatus Lea, 1857
Unio wheatleyi Lea, 1857
Unio catawbensis Lea, 1861
Unio insulsus Lea, 1857
Unio spadiceus Lea, 1857
Unio macer Lea, 1857
Unio contractus Lea, 1857
Unio virens Lea, 1857
Unio savannahensis Lea, 1857
*Unio subflavus*Lea, 1857
Unio fumatus Lea, 1857
Unio subniger Lea, 1857
Unio neusensis Lea, 1857
Unio purus Lea, 1858
Unio exactus Lea, 1858
Unio postellii Lea, 1858
Unio roswellensis Lea, 1859
Unio burkensis Lea, 1859
Unio hallenbeckii Lea,1859
Unio baldwinensis Lea, 1859
Unio salebrosus Lea, 1859
Unio raeensis Lea, 1859
Unio latus Lea, 1859
Unio quadratus Lea, 1859
Unio squameus Lea, 1861
Unio rostrum Lea, 1861
Unio northamptonensis Lea, 1861
Unio decumbens Lea, 1861
Unio raleighensis Lea, 1863
Unio aberrans Lea, 1863
Unio weldonensis Lea, 1863
Unio mecklenbergensis Lea, 1863
Unio chathamensis Lea, 1863
Unio gastonensis Lea, 1863
Unio quadrilaterus Lea, 1863
Unio indefinilus Lea, 1863
Unio indefinitus Lea, 1866
Unio mediocris Lea, 1863
Unio perlucens Lea, 1863
Unio curatus Lea, 1863
Unio protensus Lea, 1865
Unio lazarus Sowerby, 1868 in Reeve.
Unio beaverensis Lea, 1868
Unio nubilus Lea, 1868
Unio datus Lea, 1868
Unio humerosus Lea, 1868
Unio uhareensis Lea, 1868
Unio tortuosus Sowerby, 1868
Unio santeensis Lea, 1871
Unio yadkinensis Lea, 1872
Unio amplus Lea, 1872
Unio ligatus Lea, 1872
Unio differtus Lea, 1872
Unio subparallelus Lea, 1872
Unio oblongus Lea, 1872
Unio curvatus Lea, 1872
Unio irwinensis Lea, 1872
Unio subsquamosus Lea, 1872
Unio infuscus Lea, 1872
Unio ratus Lea, 1872
Unio basalis Lea, 1872
Unio dissimilis Lea, 1872
Unio cirratus Lea, 1874
Unio subolivaceus Lea, 1874
Unio infulgens Lea, 1874
Unio corneus Lea, 1874
Unio dooleyensis Lea, 1874
Unio gesnerii Lea, 1874
Unio invenustus Lea, 1874
Unio (Arconaia) provancheriana Pilsbry, 1890
Unio palliatus 'Ravenel' Simpson, 1900
Unio pullatus majusculus De Gregorio, 1914
Unio complanatus mainensis Rich, 1915
Elliptio (Elliptio) complanata (Lightfoot, 1786)

SHELL DESCRIPTION. Shell outline long, trapezoidal, to rhomboid or subelliptical, shell compressed to inflated and thin to solid, dorsal and ventral margins roughly parallel, ventral margin often straight, posterior ridge broad, double and rounded to angular, beaks low and uninflated, periostracum brownish or yellowish green becoming almost black with age often with green rays over the entire shell, lateral teeth straight, beak cavity very shallow, nacre usually purple, but white to light orange or salmon occur.

DISTRIBUTION: Alabama, Connecticut, Delaware, Florida, Georgia, Massachusetts, Maryland, Maine, Michigan, Minnesota, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, Wisconsin, West Virginia, New Brunswick, Nova Scotia, Ontario, Quebec, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:109) recorded the ecology of *Elliptio complanata* as: "It apparently has no ecological preferences, being found practically in any permanent body of water; in canals and reservoirs with quiet water and muddy bottom, as well as in large rivers with strong current and heavy gravel and rocks. In the small creeks it goes very far into the headwaters."

BREEDING SEASON. Ortmann (1919:104) reported gravid females from April to mid-July with glochidia present in early June and as late as August. This is a tachytictic species.

HOST FISH. Watters (1994:103) lists the following species as host fish for *Elliptio complanata*: banded killifish, *Fundulus diaphanus*; green sunfish, *Lepomis cyanellus*; orangespotted sunfish, *Lepomis humilis*; largemouth bass, *Micropterus salmoides*; white crappie, *Pomoxis annularis*; yellow perch, *Perca flavescens*.

STATUS. Currently stable (Williams et al. 1993).

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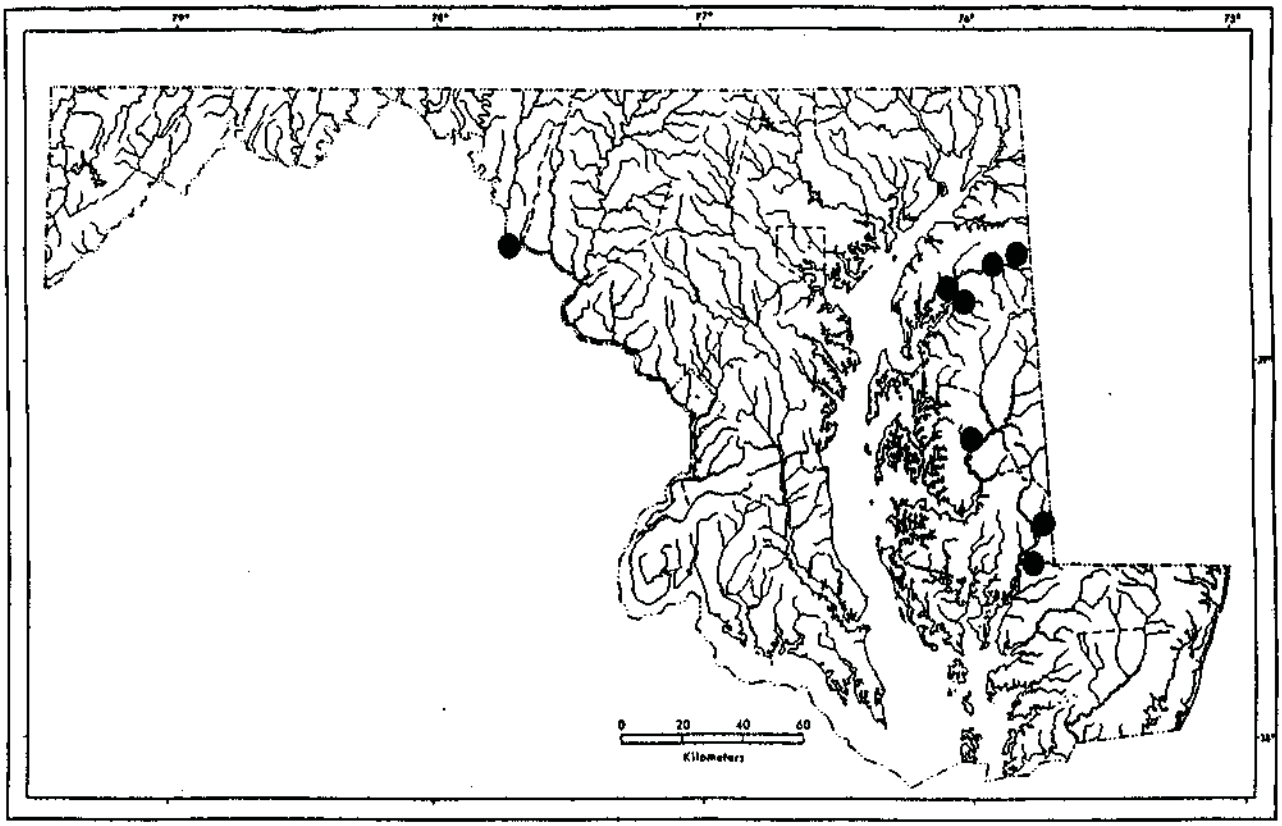
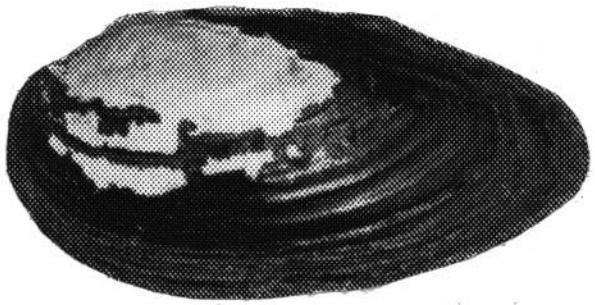


Map 9 Distribution map of *Elliptio fisheriana* (Lea, 1838) in Maryland.

Elliptio fisheriana (Lea, 1838) **northern lance** Fig. 11.

SYNONYMY.

Unio fisherianus Lea, 1838
Margarita (*Unio*) *fisherianus* (Lea, 1838)
Margaron (*Unio*) *fisherianus* (Lea, 1838)
Elliptio fisherianus (Lea, 1838)



SHELL DESCRIPTION. Shell elongate, compressed, shell thin, beaks low, posterior ridge subangular, posterior end bluntly rounded, ventral margin broadly curved, anterior end rounded, periostracum olive, green to brown and black, often with faint rays, beak cavity very shallow, nacre white to purplish.

DISTRIBUTION: Delaware, Maryland, Pennsylvania, Virginia (Williams et al. 1993).

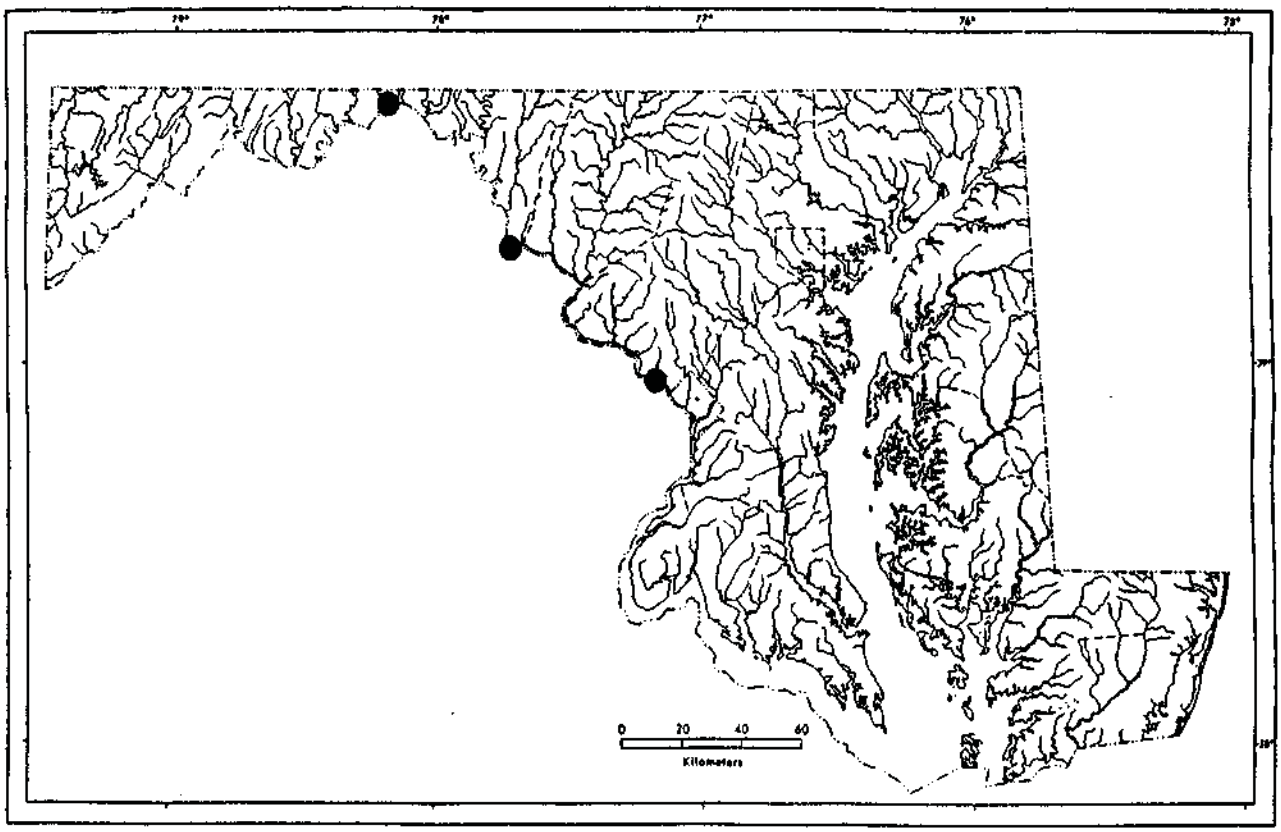
ECOLOGY. Johnson (1970:335) lists the ecology of *Elliptio lanceolata* sensu lato as "Lives on sandy bottoms, often found crawling about with much of the shell out of the sand, also found among rocks and in mud, where the current is not too swift."

BREEDING SEASON. Ortmann (1919:113) listed the breeding season of this species as unknown.

HOST FISH. Unknown (Watters 1994).

STATUS. Special concern (Williams et al. 1993).

COMMENTS. Type locality for this species is the "head of the Chester River [Kent Co.] Maryland (Johnson 1970:333).

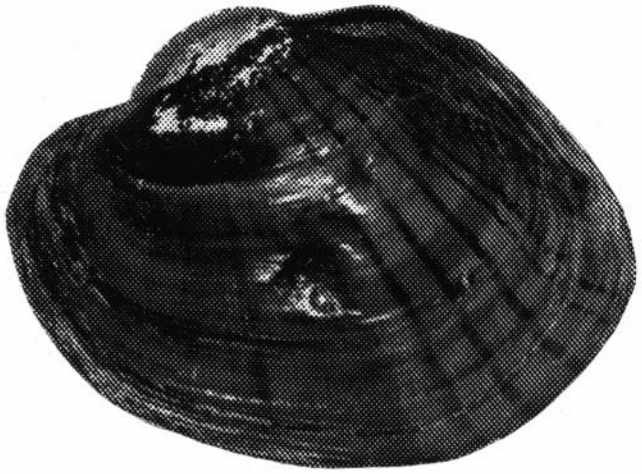


Map 10 Distribution of *Lampsilis cardium* Rafinesque, 1820 in Maryland.

Lampsilis cardium Rafinesque, 1820 **plain pocketbook** Fig. 12.

SYNONYMY.

Lampsilis cardium Rafinesque, 1820
Unio ventricosus Barnes, 1823
Unio occidens Call, 1887
Lampsilis ventricosus (Barnes, 1823)
Lampsilis ovata ventricosa (Barnes, 1823)
Unio occidens Lea, 1829
Unio subovatus Lea, 1831
Unio lenis Conrad, 1838
Unio canadensis Lea, 1857
Unio latissimus Sowerby, 1868
Lampsilis ventricosa var. *lurida* Simpson, 1914
Lampsilis ventricosa cohongoronta Ortmann, 1912
Lampsilis ventricosa winnebagoensis Baker, 1928
Lampsilis ventricosa pergloboas Baker, 1928
Lampsilis ovata ventricosa (Barnes, 1823)



SHELL DESCRIPTION. Shell globose, elliptical, female shells often more rectangular, ventral margin evenly rounded, shell relatively thin but stout, moderately inflated, posterior ridge not prominent and rounded, periostracum yellowish to tan becoming darker with age, broad to narrow rays usually cover the shell, some shells may not have rays, pseudocardinal teeth compressed, lateral teeth short, interdentum narrow, beak cavity wide and deep, nacre white. compare with *Lampsilis ovata*.

DISTRIBUTION: Alabama, Arkansas, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Missouri, Mississippi, Ohio, Oklahoma, Tennessee, Texas, West Virginia, Wisconsin (Williams et al. 1993).

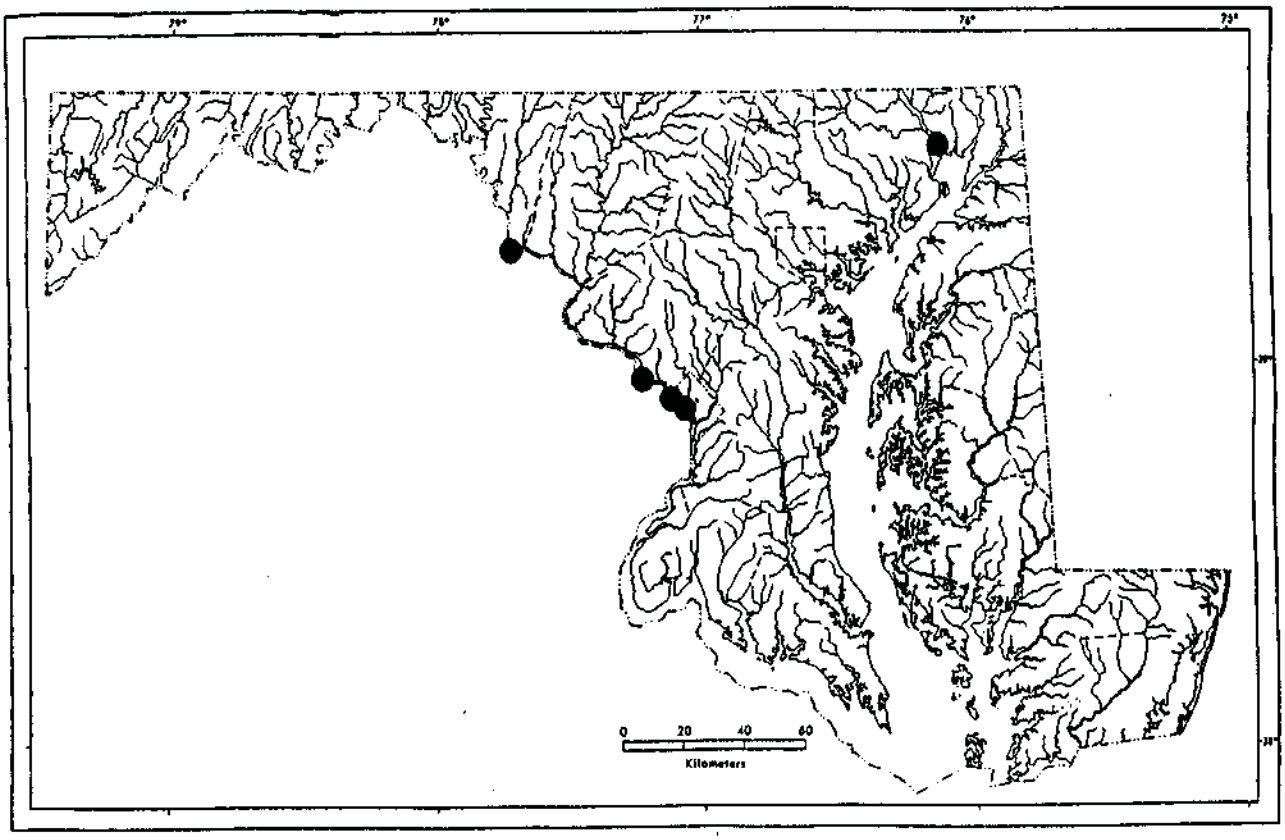
ECOLOGY. Ortmann (1919:306) listed the ecology of the species as favoring "rather quiet pools and eddies above and below riffles. Open pools in riffles, in *Dianthera*-patches, with moderate current, and a bottom of fine gravel covered with a thin layer of mud ... occasionally this form is found even in pure sand and rather deep and soft mud."

BREEDING SEASON. Ortmann (1919:303) reports gravid females from the end of July to October and May to early July. This species is bradytictic.

HOST FISH. Watters (1994:108) lists the following species as host fish for *Lampsilis cardium*: bluegill, *Lepomis macrochirus*; largemouth bass, *Micropterus salmoides*; smallmouth bass, *Micropterus dolomieu*; white crappie, *Pomoxis annularis*; sauger, *Stizostedion canadense*, walleye, *Stizostedion vitreum*; yellow perch, *Perca flavescens*.

STATUS. Special concern (Williams et al. 1993).

COMMENTS. The figure specimen is the lectotype of *Lampsilis ventricosa cohongoronta* Ortmann, 1912, CMNH 61.3994. The type locality of this subspecies is the Potomac River at Hancock, Washington County, Maryland.



Map 11 Distribution of *Lampsilis cariosa* (Say, 1817) in Maryland

Lampsilis cariosa (Say, 1817) **yellow lampmussel** Fig. 13.

SYNONYMY.

Unio cariosus Say, 1817
Margarita (*Unio*) *cariosus* (Say, 1817)
Margaron (*Unio*) *cariosus* (Say, 1817)
Lampsilis pallida Rafinesque, 1820
Unio ovata Valenciennes, 1827 PREOCCUPIED
Unio viridis Ferussac, 1835
Unio crocatus Lea, 1841
Unio oratus Conrad, 1849
Lampsilis cariosa (Say, 1817)
Lampsilis (*Lampsilis*) *cariosa* (Say, 1817)

SHELL DESCRIPTION. Shell medium size, male shell elliptical and somewhat elongate, female shells subobovate to obovate, moderately inflated, thick, anterior margin rounded, ventral margin slightly curved, dorsal margin straight, posterior ridge rounded, umbos swollen, and raised just above the hinge line and located anterior of the midline of the shell, periostracum shiny, waxy or straw yellow, becoming darker brownish yellow, green or black rays when present usually restricted to the posterior slope, pseudocardinal teeth compressed, beak cavity moderately deep, nacre color white or tinged with salmon.

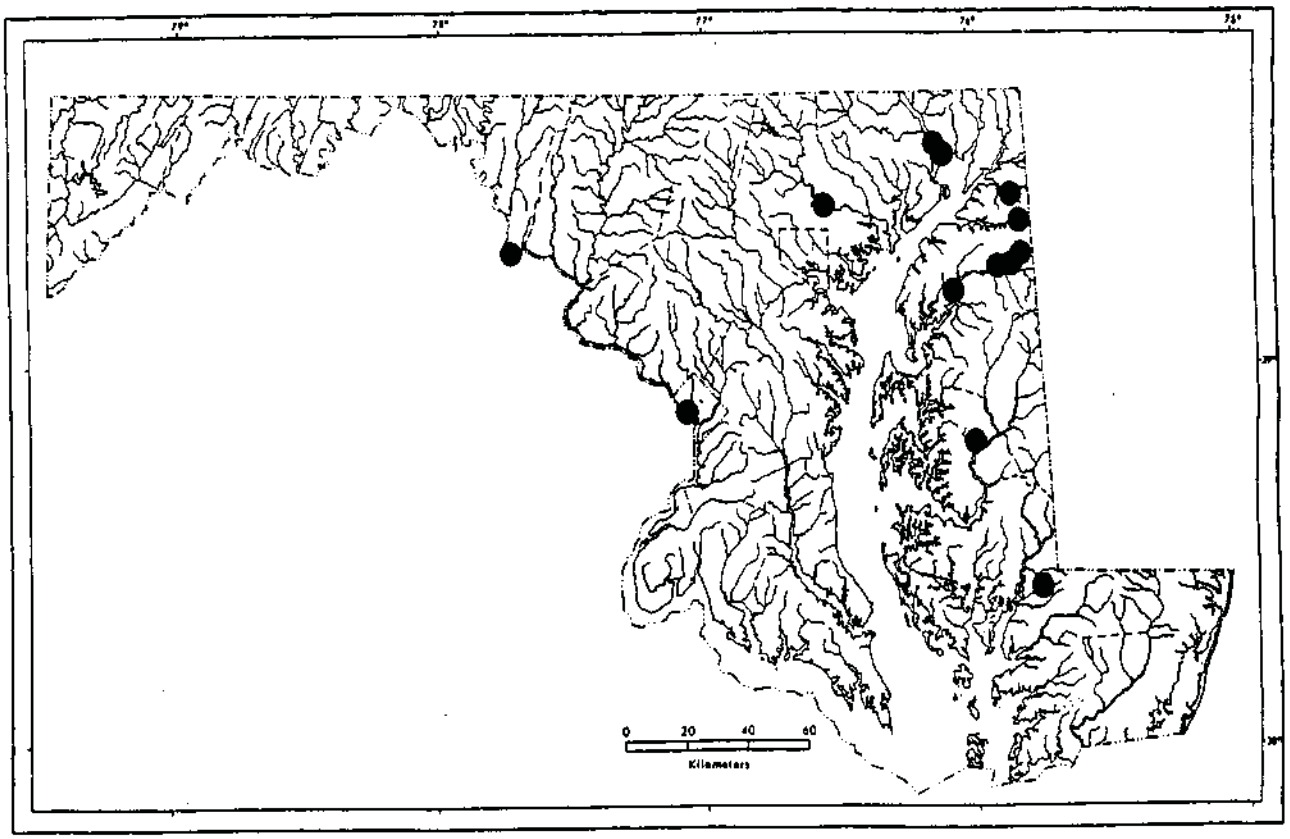
DISTRIBUTION: Connecticut, Delaware, Georgia, Massachusetts, Maine, Maryland, North Carolina, New Jersey, New York, Pennsylvania, South Carolina, Virginia, New Brunswick, Nova Scotia, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:317) reported "Where found this species is generally abundant, even in smaller streams ... It is always found in lively currents, on shoals and riffles, in finer or coarser gravel, and very often in bars of pure sand."

BREEDING SEASON. Ortmann (1919:315) was only able to establish gravid females in August, with glochidia appearing in late August. This is a bradytictic species releasing glochidia in the spring or early summer.

HOST FISH. Unknown (Watters 1994).

STATUS. Threatened (Williams et al. 1993). Maryland DNR listed this species as extinct in Maryland (Anonymous, 1994).

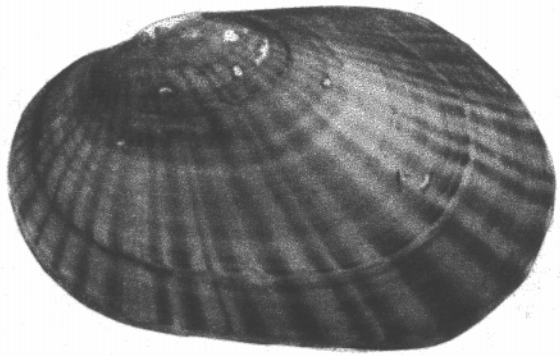


Map 12 Distribution of *Lampsilis radiata* (Gmelin, 1791) in Maryland

Lampsilis radiata (Gmelin, 1791) **eastern lampmussel** Fig. 14.

SYNONYMY.

Mya radiata Gmelin, 1791
Unio luteola Lamarck, 1819
Unio lineata 'Valenciennes' Bory de St. Vincent, 1827
Unio tenebrosus Conrad, 1834
Unio melinus Conrad, 1838
Unio boydianus Lea, 1840
Unio rosaceus De Kay, 1843
Mya oblongata Wood, 1856
Unio elongata S.G. Goodrich, 1858
Unio obliquiradiatus Reeve, 1865
Unio conspicuus Lea, 1872
Unio virginiana Simpson, 1900
Lampsilis radiata (Gmelin, 1791)
Lampsilis radiata oneidensis Baker, 1916
Unio virginea Frierson, 1927
Lampsilis radiata radiata (Gmelin, 1791)
Lampsilis radiata var. *conspicua* (Lea, 1872)
Lampsilis (*Lampsilis*) *radiata radiata* (Gmelin, 1791)



SHELL DESCRIPTION. Shell medium to large, subelliptical or subovate in outline, moderately elongate, valves from not inflated to quite inflated, and solid, anterior end rounded, posterior end in females broadly expanded and rounded, dorsal margin straight and ventral margin straight to gently curved, posterior ridge mostly absent, posterior slope broad, beaks rather sharp but not very inflated, periostracum yellowish or brownish green with dark green rays over the entire surface, no interdentum, beak cavity shallow, nacre white, may be tinged with pink or salmon.

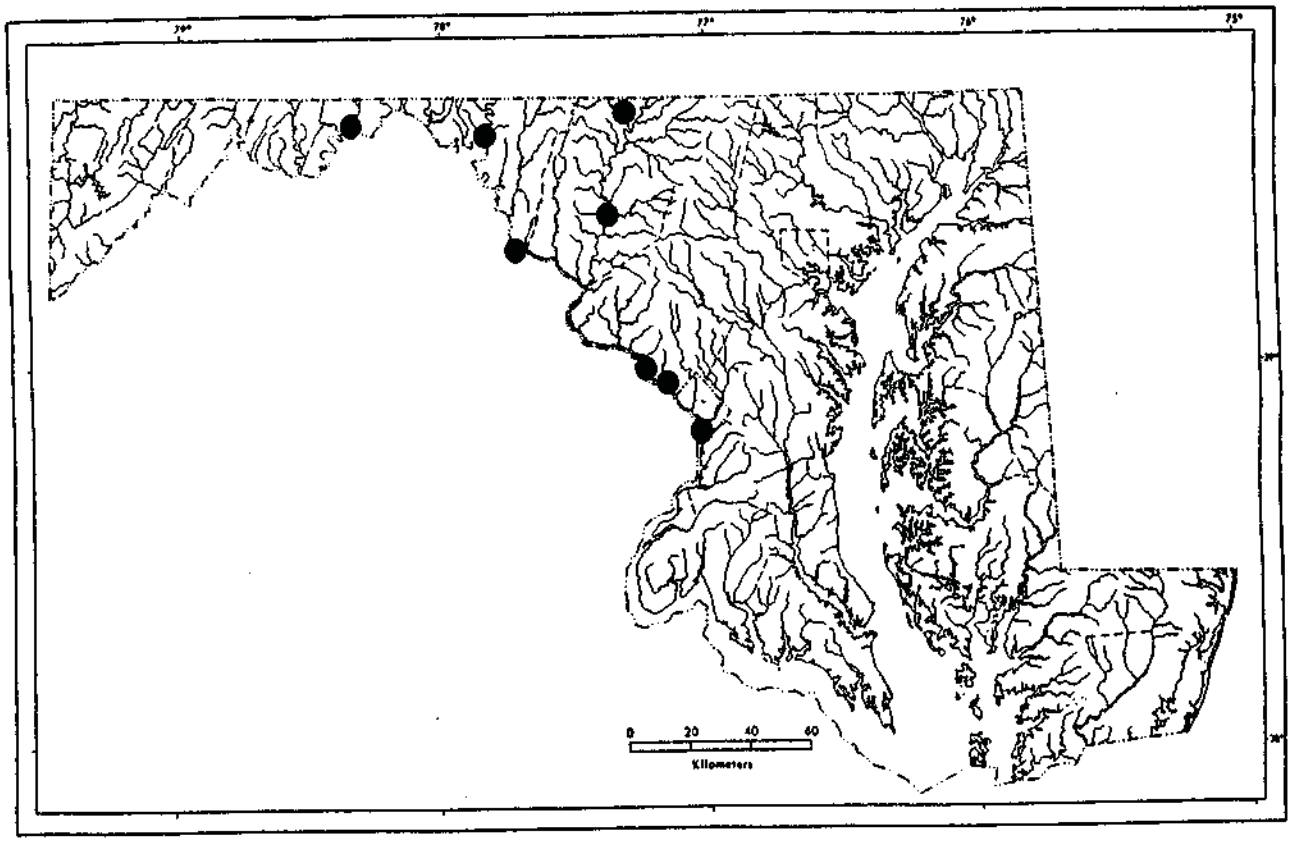
DISTRIBUTION: Connecticut, Delaware, Massachusetts, Maryland, Maine, Michigan, North Carolina, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, West Virginia, New Brunswick, Nova Scotia, Ontario, Quebec, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:317) recorded this species "Where found, this species is generally abundant, even in smaller streams ... It is always found in lively current, on shoals and riffle, in finer or coarser gravel, and very often in bars of pure sand."

BREEDING SEASON. Ortmann (1919:293) only reported gravid females in late August and glochidia in gravid females in late August.

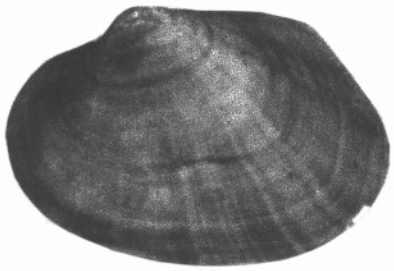
HOST FISH. Watters (1994:107) lists the following species as host fish for *Lampsilis radiata*: rockbass, *Ambloplites rupestris*; pumpkinseed, *Lepomis gibbosus*; largemouth bass, *Micropterus salmoides*; smallmouth bass, *Micropterus dolomieu*; black crappie, *Pomoxis nigromaculatus*; yellow perch, *Perca flavescens*.

STATUS. Currently stable (Williams et al. 1993).



Map 13 Distribution of *Lasmigona subviridis* (Conrad, 1835) in Maryland.

Lasmigona subviridis (Conrad, 1835) **green floater** Fig. 15.



SYNONYMY.

Unio subviridis Conrad, 1835
Unio tappanianus Lea, 1838
Unio hyalinus Lea, 1845
Margaritana quadrata Lea, 1861
Unio pertenius Lea, 1863
Lasmigona (*Platynaias*) *subviridis* (Conrad, 1835)

SHELL DESCRIPTION. Shell ovate trapezoid, thin and rather fragile, beaks only projecting slightly above the hinge line, posterior ridge rounded, periostracum light yellow or brown with numerous green rays especially in juveniles, pseudocardinal and lateral teeth small and delicate, beak cavity shallow, nacre whitish to bluish and iridescent posteriorly.

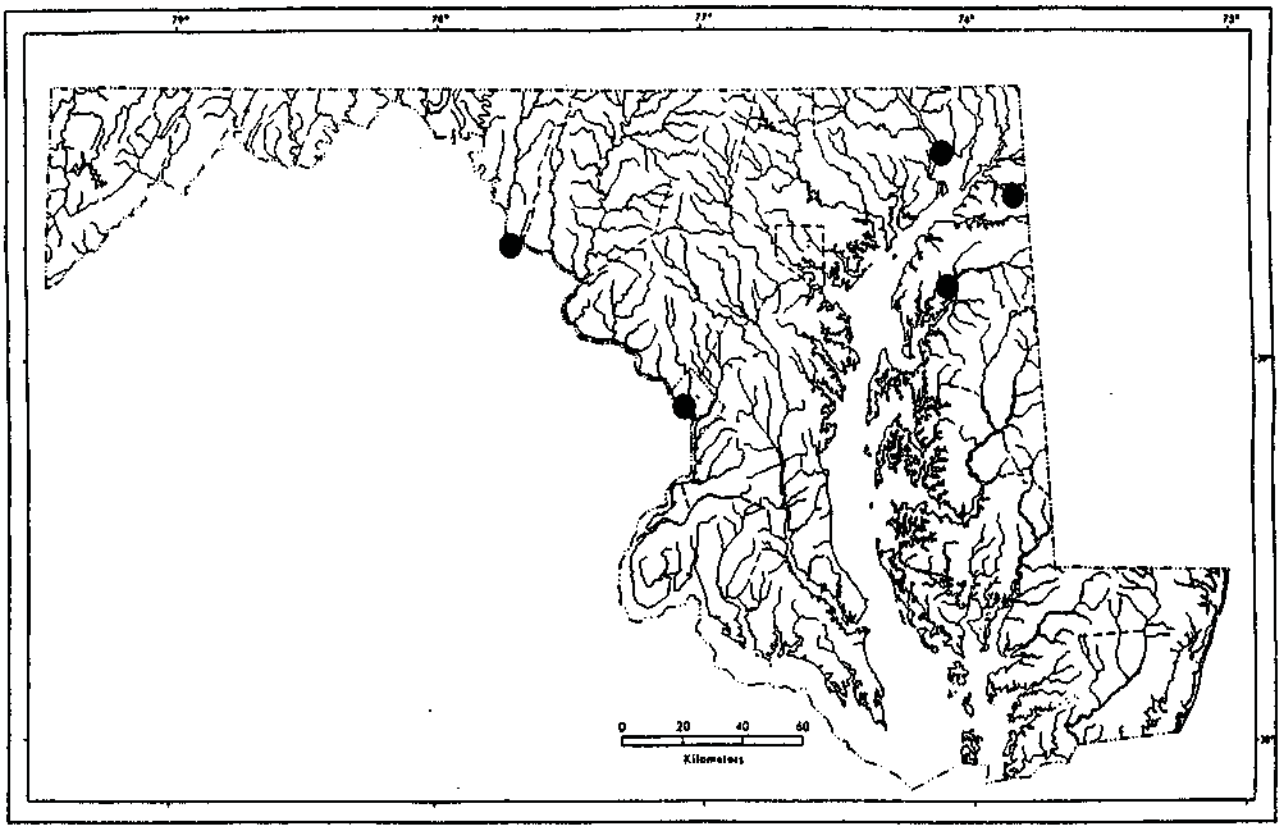
DISTRIBUTION. Georgia, Kentucky, Maryland, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia (Williams et al. 1993).

ECOLOGY. Ortmann (1919:124) listed the ecology of this species: "this species is very erratic in its distribution. ... The specimens found by myself in larger rivers generally were few, and often in small branches of the river. But even in small streams, it is not everywhere present. ... it is averse to very strong current, and prefers more quiet parts, pools or eddies with gravelly and sandy bottoms, and it also goes into canals."

BREEDING SEASON. Ortmann (1919:122) reported gravid females from August to September and April to June, a bradytictic species.

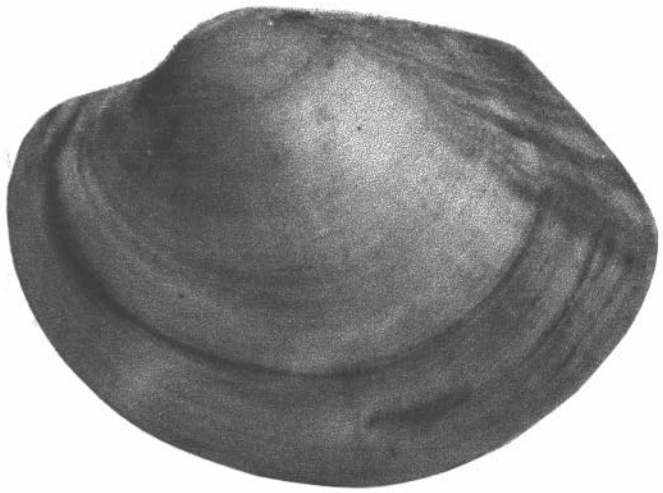
HOST FISH. Unknown (Watters 1994).

STATUS. Threatened (Williams et al. 1993).



Map 14 Distribution of *Leptodea ochracea* (Say, 1817) in Maryland.

Leptodea ochracea (Say, 1817) **tidewater mucket** Fig. 16.



SYNONYMY.

Mytilus fluviatilis Gmelin 1791 (Nomen dubium)
Unio ochraceus Say, 1817
Lampsilis rosea Rafinesque, 1820
Unio rosaceus Conrad, 1849
Lampsilis ochracea (Say, 1817)
Lampsilis (*Lampsilis*) *ochracea* (Say, 1817)
Leptodea ochracea (Say, 1817)

SHELL DESCRIPTION. Shell relatively small, male shell elliptical and female more ovate, shell subinflated and thin, and strong, anterior end rounded, posterior margin evenly rounded, somewhat pointed in males and truncated in females, posterior ridge rounded, often with a few ridges or wrinkles, beaks moderately swollen and raised above the hinge line, located near the middle of the shell, periostracum slightly shiny, brownish olive, greenish-yellow, yellow or reddish yellow, often with fine green rays, over most of the shell, pseudocardinal teeth compressed, lateral teeth short and curved, beak cavities shallow, nacre white or pinkish.

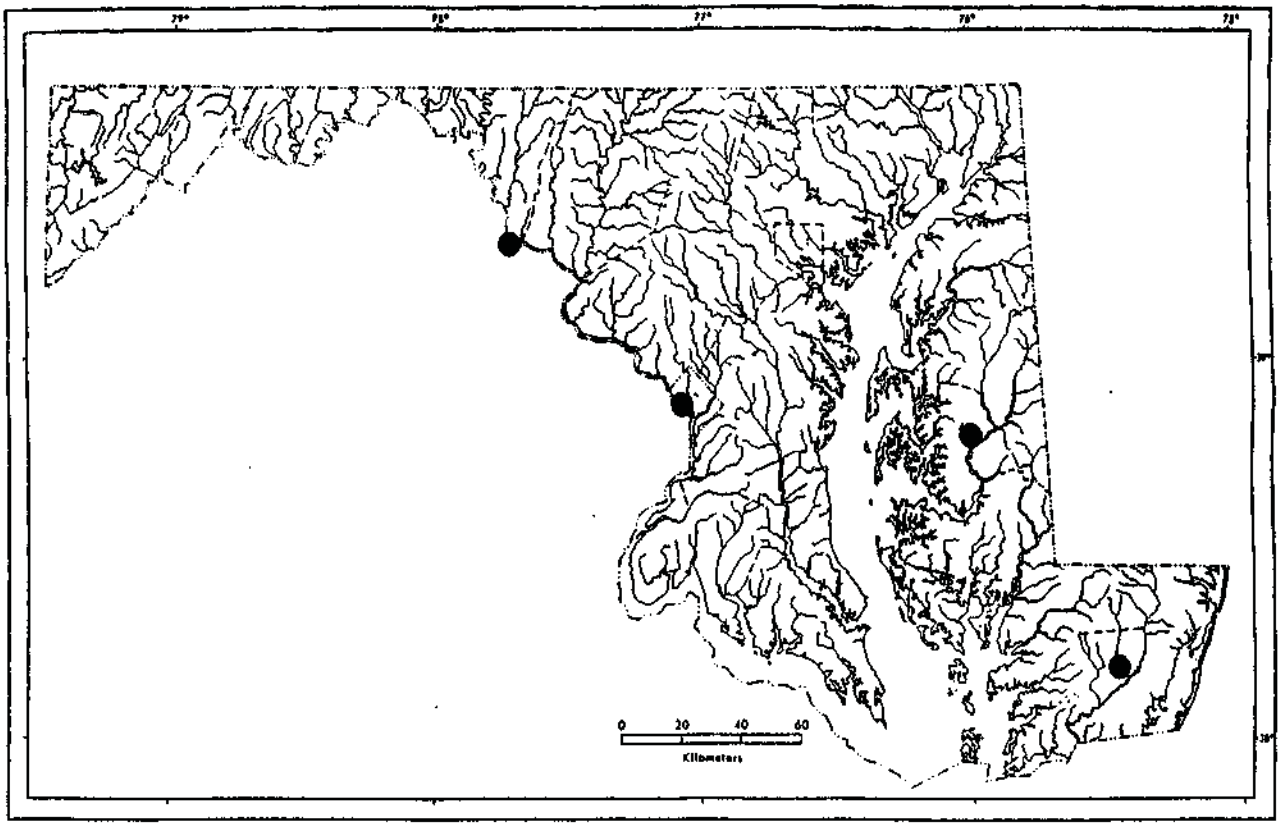
DISTRIBUTION: Connecticut, Delaware, Georgia, Massachusetts, Maryland, Maine, North Carolina, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, New Brunswick, Nova Scotia, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:320) noted *Leptodea ochracea* was found in "most tide waters north of the Savannah River. ... It is a form of estuaries, ponds, canals, and ditches, probably with more or less muddy bottoms."

BREEDING SEASON. Ortmann (1919:319) noted that Isaac Lea had reported this species was gravid in the autumn (October, November). There is a lack of information on the anatomy and biology of this species.

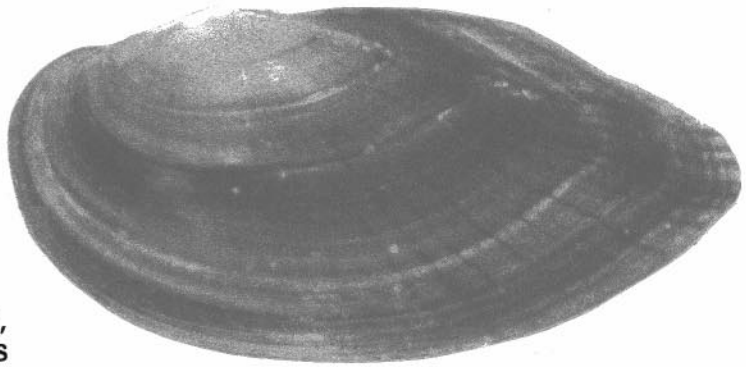
HOST FISH. Unknown (Watters 1994).

STATUS. Special concern (Williams et al. 1993).



Map 15 Distribution of *Ligumia nasuta* (Say, 1817) in Maryland.

Ligumia nasuta (Say, 1817) **eastern pondmussel** Fig. 17.



SYNONYMY.

Unio nasutus Say, 1817
Obliquaria attenuata Rafinesque, 1820
Unio rostrata Valenciennes, 1827
Unio vaughanianus Sowerby, 1868
Unio fisherianus Kuester, 1860 non Lea, 1838
Lampsilis nasuta (Say, 1817)
Eurynia nasuta (Say, 1817)
Ligumia nasuta (Say, 1817)

SHELL DESCRIPTION. Shell elongated, subelliptical, shell is over twice as long as high, shell rather thin, subinflated, posterior end bluntly pointed, dorsal margin straight, ventral margin curved, posterior ridge distinct, beaks low and located in anterior quarter of the shell, periostracum greenish yellow, to dark olive or brown sometimes with distinct narrow rays, beak cavity shallow, lateral teeth long and straight, pseudocardinal teeth compressed, nacre white. Male shells taper to a blunt point posteriorly, female shell is distinctly swollen posteriorly.

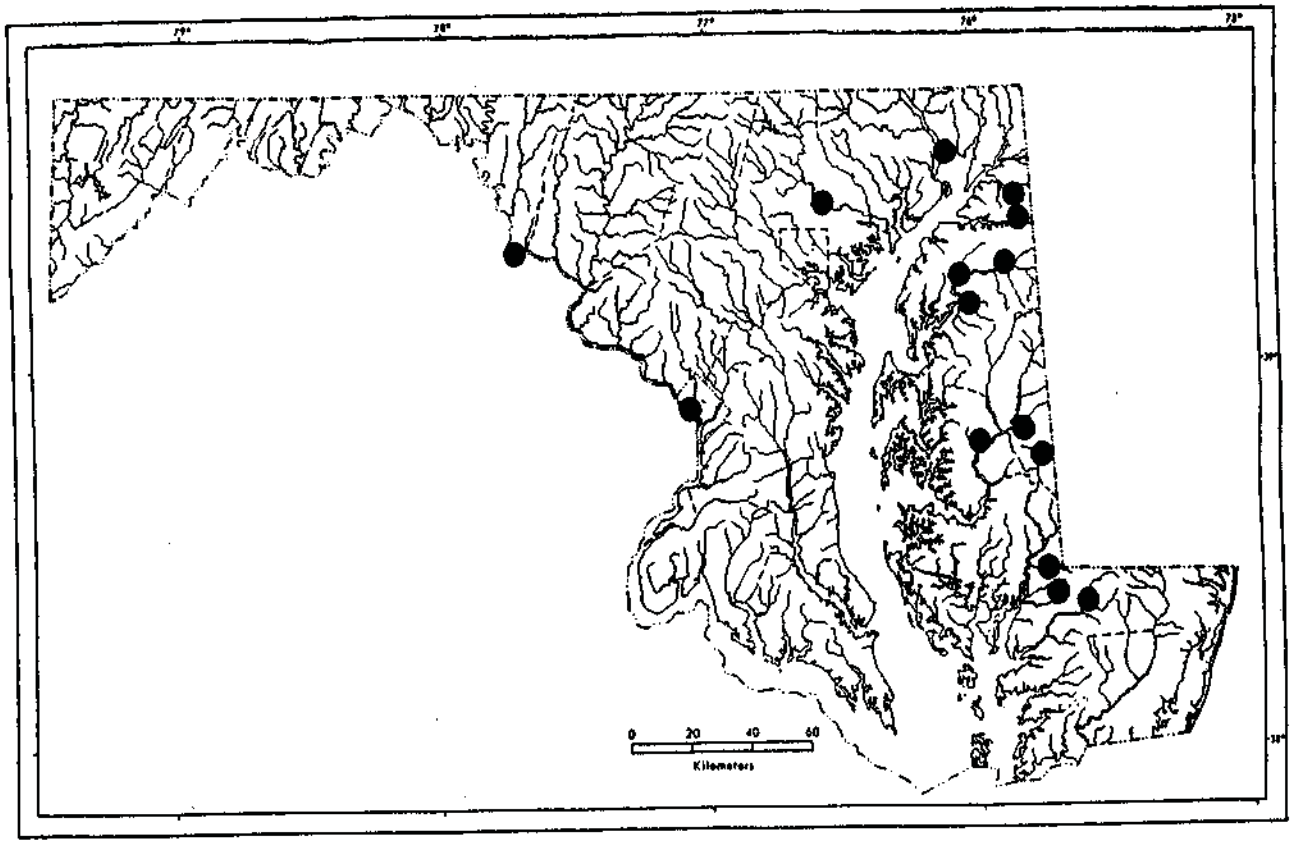
DISTRIBUTION: Connecticut, Delaware, Massachusetts, Maryland, Maine, Michigan, North Carolina, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Virginia, Ontario, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:275) recorded the ecology of this species as "Sandy bottom of great, quiet bodies of water (tidewaters, lakes and probably also canals) seem to furnish the conditions most favorable to this species."

BREEDING SEASON. Ortmann (1919: reported gravid females from eastern Pennsylvania from September and May. He noted gravid females from Lake Erie from August to early July, a bradytictic species.

HOST FISH. Unknown (Watters 1994).

STATUS. Special concern (Williams et al. 1993).

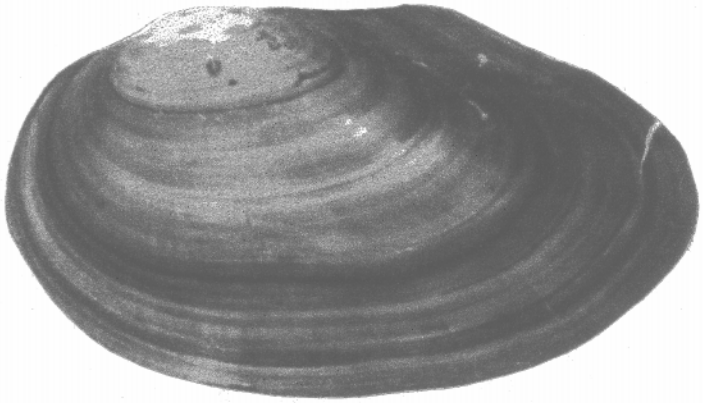


Map 16 Distribution of *Pyganodon cataracta* (Say, 1817) in Maryland.

Pyganodon* (=*Anodonta*) *cataracta (Say, 1817) **eastern floater** Fig. 18.

SYNONYMY.

Anodonta cataracta Say, 1817
Anodonta marginata Say, 1817
Anodonta teres Conrad, 1834
Anodon excurvata De Kay, 1843
Anodonta virgulata Lea, 1857
Anodonta lacustris Lea, 1857
Anodonta hallenbeckii Lea, 1858
Anodonta gesnerii Lea, 1858
Anodonta dariensis Lea, 1858
Anodonta williamsii Lea, 1862
Anodonta tryoni Lea, 1862
Anodonta dolearis Lea, 1863
Anodonta doliaris Lea, 1866
Anodonta (*Pyganodon*) *cataracta cataracta* Say, 1817



SHELL DESCRIPTION. Shell medium to large, outline subelliptical and elongate, shells of juveniles not much inflated but much inflated in adult shells, shell thin, posterior margin pointed, ventral margin straight to slightly curved, posterior ridge indistinct, posterior slope often with two faint ridges, beaks slightly swollen, located in anterior third of shell, periostracum usually smooth, shiny, straw yellow to light green grading to a dark green, rays on posterior slope darker, rays on disk of the shell, no teeth are present, muscle scars poorly defined, nacre bluish white.

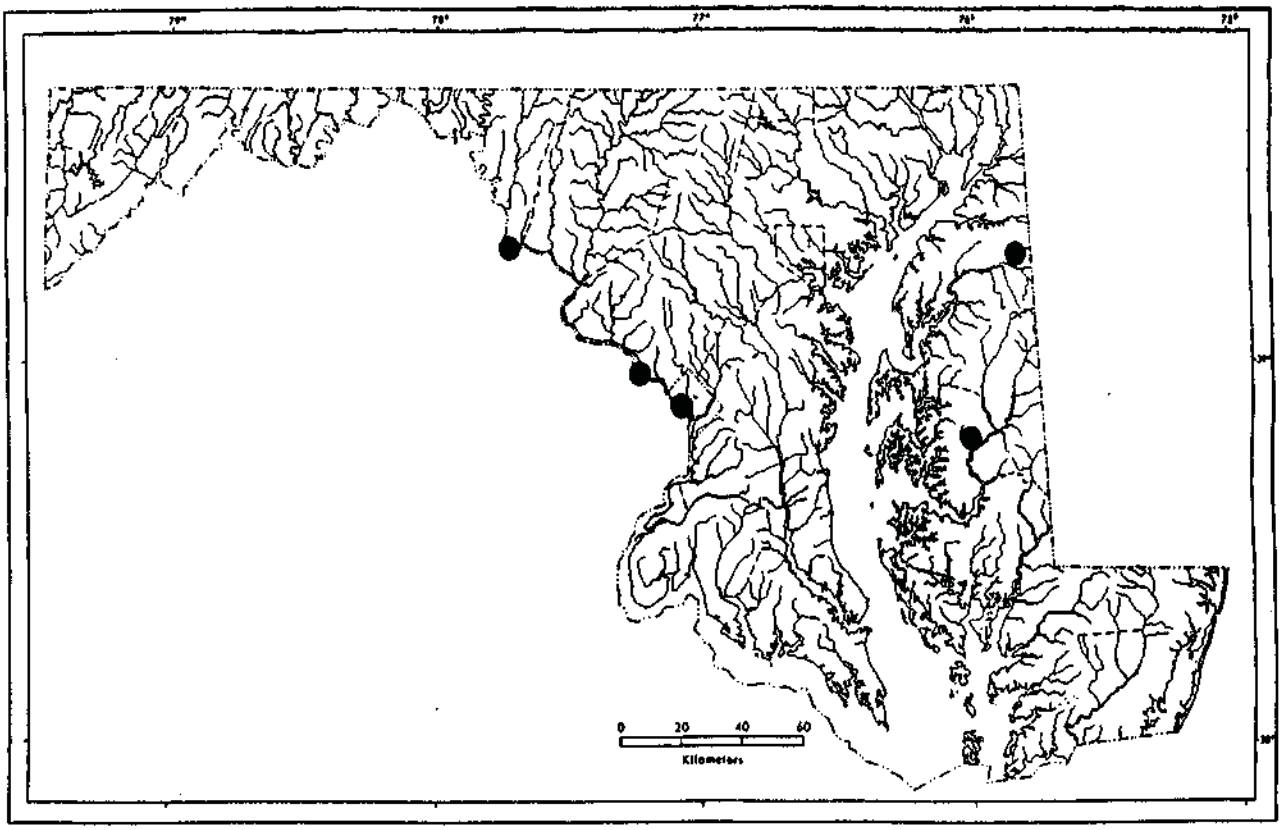
DISTRIBUTION: Alabama, Connecticut, Delaware, Georgia, Massachusetts, Maryland, Maine, Michigan, North Carolina, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Virginia, Vermont, Wisconsin, West Virginia, New Brunswick, Nova Scotia, Ontario,PE, Quebec, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:158) noted a creek and a pond form of this species and remarked about the species: "I collected the pond-form in rather small (artificial) ponds, with very muddy bottoms, and also, but more rarely, in quiet pools in creeks. ... the creek-form ... It seems to avoid the larger rivers ... It favors smaller rivers and creeks. Here it lives on gravelly bottoms, in more or less strongly flowing water (even in riffles), or in more quiet pools in gravel, sand, or mud. The short high form ... seems to prefer large rivers with muddy bottoms."

BREEDING SEASON. Ortmann (1919:153) reported gravid females from late July to late April and noted the species is listed as gravid until May, a bradytictic species.

HOST FISH. Watters (1994:99) lists the following species as host fish for *Pyganodon cataracta* as: carp, *Cyprinus carpio*; pumpkinseed, *Lepomis gibbosus*; threespine stickleback, *Gasterosteus aculeatus*; white sucker, *Catostomus commersoni*.

STATUS. Currently stable (Williams et al. 1993).

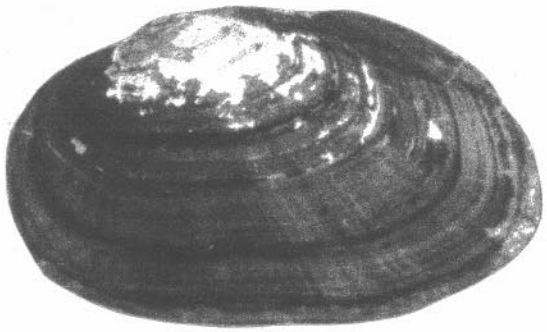


Map 17 Distribution of *Strophitus undulatus* (Say, 1817) in Maryland.

Strophitus undulatus (Say, 1817) **squawfoot** Fig. 19.

SYNONYMY.

Anodonta undulata Say, 1817
Alasmodonta edentula Say, 1820
Anodon rugosus Swainson, 1822
Anodonta arkansensis Call, 1885
Anodonta edentula (Say, 1817)
Strophitus edentulus (Say, 1817)
Strophitus rugosus (Swainson)
Anodonta pensylvanica [sic] Lamarck, 1819
Anodon areolatus Swainson, 1829
Alasmodonta edentula Say, 1829
Anodonta virgata Conrad, 1836
Anodonta pavonia Lea, 1836
Anodonta wardiana Lea, 1838
Anodon unadilla De Kay, 1843
Anodonta tetragona Lea, 1845
Anodonta arkansensis Lea, 1852
Anodonta shaefferiana Lea, 1852
Alasmodon rhombica Anthony, 1865
Anodon papyracea Anthony, 1865
Anodon annulatus Sowerby, 1867
Anodon quadriplicatus Sowerby, 1867
Anodonta salmonia Clessin, 1873
Strophitus undulatus ovatus Frierson, 1927
Strophitus rugosus pepinensis Baker, 1928
Strophitus rugosus winnebagoeinsis Baker, 1928
Strophitus rugosus lacustris Baker, 1928
Strophitus edentulus (Say, 1817)



SHELL DESCRIPTION. Shell oblong oval, dorsal and ventral margins rounded, shell thin and fragile when young but becoming thicker, length to 11 cm. compressed to inflated, posterior ridge rounded, beaks narrow but only slightly raised above the hinge, periostracum yellow-brown to greenish becoming darker with age, green rays may cover the shells. Pseudocardinal teeth are only swellings or thickening along the hinge, lateral teeth absent, beak cavity shallow, hinge line undulate, nacre white with cream color in beak cavity.

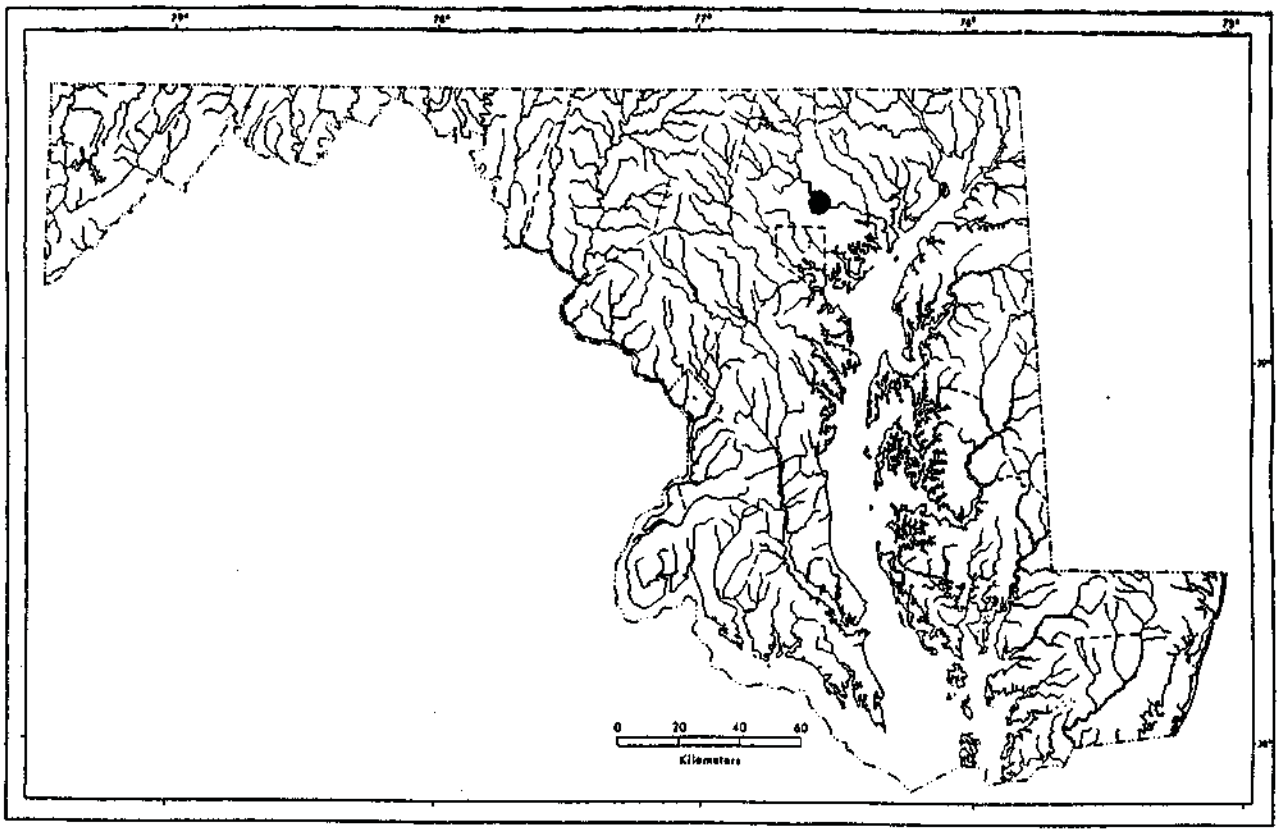
DISTRIBUTION: Alabama, Arkansas, Colorado, Connecticut, Delaware, Georgia, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Maryland, Maine, Michigan, Minnesota, Missouri, Mississippi, North Carolina, North Dakota, Nebraska, New Hampshire, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Virginia, Vermont, Wisconsin, West Virginia, Manitoba. New Brunswick, Nova Scotia, Ontario, Quebec, Saskatchewan, Canada (Williams et al. 1993).

ECOLOGY. Ortmann (1919:204-205) reported "it is distinctly averse to large rivers. ... We may ... call *S. edentulus* a form characteristic of smaller streams ... Baker ... says indeed that it is found in the larger lakes and rivers on muddy bottoms, while Scammon ... reports it to prefer mud and quiet water, and to be the most abundant in small streams (in Kansas). ... in the small streams it avoids riffles, but delights in quiet and protected nooks, pools, and eddies, where there is a moderate and rather uniform current, and a deposit of fine gravel, or sand."

BREEDING SEASON. Ortmann (1919:196) reported that the Atlantic slope individuals were "gravid in December and March, but not in April and May." He noted that the Ohio River basin populations (listed as *Strophitus edentulus*) were gravid from July to November and April to May, a typical bradytictic species (Ortmann 1919:198).

HOST FISH. Watters (1994:113) lists the following species as host fish for *Strophitus undulatus* as: creek chub, *Semotilus atromaculatus*; largemouth bass, *Micropterus salmoides*. Other authors have noted that no host fish is need or have listed "several fish".

STATUS. Currently stable (Williams et al. 1993).



Map 18 Distribution of *Utterbackia imbecillis* (Say, 1829) in Maryland.

Utterbackia* (=*Anodonta*) *imbecillis Say, 1829 **paper pondshell** Fig. 20.

SYNONYMY.
Anodonta imbecillis Say, 1829
Anodonta imbecilis [sic] Say, 1829
Anodonta incert Lea, 1834
Anodon horda Gould, 1855
Anodonta henryana Lea, 1857
Utterbackia imbecillis fusca Baker, 1927
Anodonta ohiensis Rafinesque, 1820 [in part]
Anodonta (*Utterbackia*) *imbecilis* Say, 1829

SHELL DESCRIPTION. Shell elongate, oblong, dorsal hinge line rather short and straight, the ventral margin rounded, shell inflated and thin growing to about 10 cm in length, beaks flat, not above the hinge line, beaks on the anterior third of the shell, periostracum shiny, light yellow on the umbo, rest of shell bright green with rays and posterior slope area is dark to black, both valves edentulous, nacre bluish-white, often with pink tinges.

DISTRIBUTION: Alabama, Arkansas, Florida, Georgia, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Missouri, Mississippi, North Carolina, Nebraska, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, Wisconsin, West Virginia, Ontario, Canada, Mexico (Williams et al. 1993).

ECOLOGY. Johnson (1970:364) noted "Lives in soft mud or sand in ponds, creeks, and near the banks of larger rivers."

BREEDING SEASON. Ortmann (1919:163) listed this species as bradytictic the females beginning gravid in June and July and discharging glochidia in May noted "the succeeding breeding seasons overlap in June and July, but probably not in the same individual." This species is simultaneous hermaphrodite (Hoeh 1991).

HOST FISH. Watters (1994:113) lists the following species as host fish for *Utterbackia imbecillis* as: banded killifish, *Fundulus diaphanus*; creek chub, *Semotilus atromaculatus*; rockbass, *Ambloplites rupestris*; bluegill, *Lepomis macrochirus*; dollar sunfish, *Lepomis marginatus*; green sunfish, *Lepomis cyanellus*; longear sunfish, *Lepomis megalotis*; pumpkinseed, *Lepomis gibbosus*; warmouth, *Lepomis gulosus*; largemouth bass, *Micropterus salmoides*; western mosquitofish, *Gambusia affinis*; yellow perch, *Perca flavescens* .

STATUS. Currently stable (Williams et al. 1993).

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Fig. 2 *Dreissena polymorpha* (Pallas, 1771)

Fig. 3 *Corbicula fluminea* (Müller, 1776)

Fig. 4 *Alasmidonta heterodon* (Lea, 1829)

Fig. 5 *Alasmidonta marginata susquehannae* Ortmann, 1919

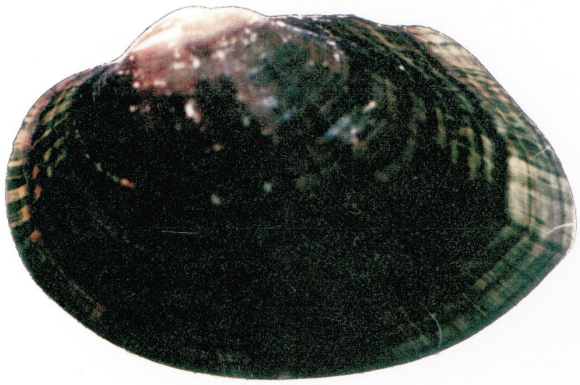

Fig. 6 *Alasmidonta undulata* (Say, 1817)

Fig. 7 *Alasmidonta varicosa* (Lamarck, 1819)

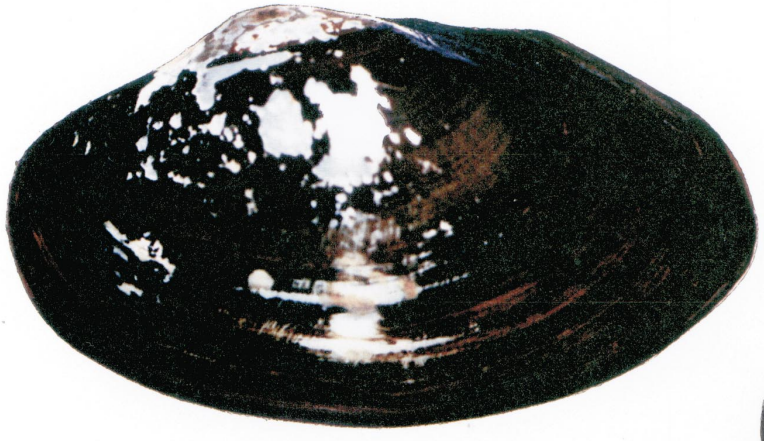

Fig. 8 *Anodonta implicata* Say, 1829

Fig. 9 *Elliptio angustata* (Lea, 1831

Fig. 10 *Elliptio complanata* (Lightfoot, 1786)

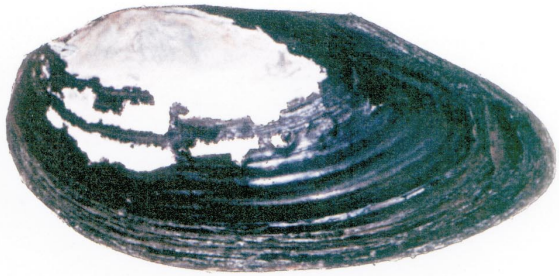

Fig. 11 *Elliptio fisheriana* (Lea, 1838)

Fig. 12 *Lampsilis cardium* Rafinesque, 1820

Fig. 13 *Lampsilis cariosa* (Say, 1817)

Fig. 14 *Lampsilis radiata* (Gmelin, 1791)

Fig. 15 *Lasmigona subviridis* (Conrad, 1835)

Fig. 16 *Leptodea ochracea* (Say, 1817)

Fig. 17 *Ligumia nasuta* (Say, 1817)

Fig. 19 *Strophitus undulatus* (Say, 1817)

Fig. 18 *Pyganodon cataracta* (Say, 1817)

Fig. 20 *Utterbackia imbecillis* (Say, 1829)

INTRODUCTION TO THE LITERATURE ON FRESHWATER BIVALVES

1. Sphaeriidae

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f. Food

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APPENDIX 1

Freshwater bivalves reported from the Youghiogheny and Casselman rivers in Pennsylvania and potentially occurring in Maryland[1].

	Youghiogheny River	Casselman River
Actinonaias ligamentina	HA[2]	-
Amblema plicata	A	-
Cyclonaias tuberculata	A	-
Elliptio crassidens	A	-
Elliptio dilatata	A	A
Epioblasma torulosa rangiana	A	-
Fusconaia flava	A	-
Fusconaia subrotunda	A	-
Lampsilis abrupta	A	-
Lampsilis fasciola	A	-
Lampsilis ovata	A	-
Lampsilis siliquoidea	A	-
Lasmigona costata	A	-
Ligumia recta	A	-
Obovaria retusa	A	-
Obovaria subrotunda	A	-
Pleurobema clava	A	-
Pleurobema cordatum	A	-
Pleurobema sintoxia	A	-
Ptychobranchus fasciolaris	A	-
Strophitus undulatus	HA	A
Villosa fabalis	A	-
TOTAL TAXA	22	2

[1] Historic data for the Youghiogheny and Casselman rivers is derived from Ortmann (1919). The archaeological data is from Winters (n.d.), an unpublished manuscript on file in the Div. of Anthropology, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania.

[2] H - Historic record; A - Archaeological record.